INPUT

STRATEGIC MARKET PERSPECTIVE

Systems Integration in Discrete and Process Manufacturing

U.S. Systems Integration Program

JANUARY 1994

SYSTEMS INTEGRATION IN DISCRETE AND PROCESS MANUFACTURING

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1881 Landings Drive
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Systems Integration Program

Systems Integration in Discrete and Process Manufacturing

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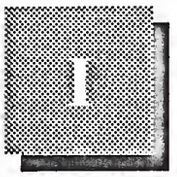

Introduction

This section identifies the purpose and scope of this report, notes how the document is organized and explains the INPUT research methodology used in its preparation.

A
Purpose

This report identifies key opportunities for systems integration providers who serve the process and discrete sectors of the manufacturing industry.

INPUT defines the *process manufacturing* sector as:

- Including all companies that fall within the Standard Industrial Classification (SIC) codes of 10xx, 12xx, 13xx, 14xx, 20xx, 21xx, 22xx, 24xx, 26xx, 28xx, 29xx, 30xx, 32xx and 33xx, as shown in Exhibit I-1. Hybrid companies incorporate both discrete and process operations to produce their products.

- Using a process operation defined by identifying a material's form at the beginning of an operation and its form after use. If the material changes form during production and cannot be uniquely identified in the end product, then a process operation probably occurred. Additionally, if the original material cannot be brought back to its original form, then a process changed it.

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EXHIBIT I-1

Process Manufacturing Sector

SIC Code	Description
10xx	Metal mining
12xx	Coal mining
13xx	Oil and gas extraction
14xx	Mining/quarrying nonmetallic minerals
20xx	Food and kindred products
21xx	Tobacco products
22xx	Textile mill products
24xx	Lumber and wood products, except furniture
26xx	Paper and allied products
28xx	Chemicals and allied products
29xx	Petroleum refining and related industries
30xx	Rubber and miscellaneous plastic products
32xx	Stone, clay, glass and concrete products
33xx	Primary metal industries

INPUT defines the *discrete manufacturing* sector as:

- Including companies that fall within the Standard Industrial Classification (SIC) Codes of 23xx, 25xx, 27xx, 31xx, and 34xx-39xx, as shown in Exhibit I-2.

- Following the form of a material used at the beginning of a manufacturing process and noting whether its form changed after use. Typically a purely discrete operation is one of assembly; the basic form of the components do not change as a result of that assembly.

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EXHIBIT I-2

Discrete Manufacturing Sector

SIC Code	Description
23xx	Apparel and other finished products
25xx	Furniture and fixtures
27xx	Printing, publishing and allied industries
31xx	Leather and leather products
34xx	Fabricated metal products, except machinery and transportation equipment
35xx	Industrial and commercial machinery and computer equipment
36xx	Electronic and other electrical equipment and components, except computer equipment
37xx	Transportation equipment
38xx	Instruments; photo/med/optical goods; watches/clocks
39xx	Miscellaneous manufacturing industry

Current successful business practices incorporating Total Quality Management (TQM) principles blur the lines between discrete and process definitions. Utilizing concepts of continuous flow, flexible manufacturing, process control, 100% quality, 100% service, reduced cycle times and increased customer responsiveness forecasts blending the best of process and discrete practices. The concept implementation indicates an increased use of automation and information services in the market; it also predicts a redirection of marketing, development and delivery practices for vendors of such services.

B

Organization

In addition to this introductory chapter, the report contains analyses of the systems integration information technology market and competitive environment as described below:

- Chapter II, *Executive Overview,* provides a summary of the remaining chapters, which includes analysis of manufacturers' requirements for systems integration services and recommendations for successful penetration of discrete and process manufacturing systems integration markets.

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- Chapter III, *User Requirements and Analysis,* draws conclusions from INPUT user surveys regarding particular systems applications needs of U.S. manufacturers and their criteria for choosing third-party systems integrators.

- Chapter IV, *Discrete and Process Manufacturing, Trends and Issues,* analyzes major information systems trends in the manufacturing sectors and notes issues for vendors in addressing these trends.

- Chapter V, *Keys to Success in Penetrating Discrete and Processing Manufacturing SI Markets,* provides analyses of ingredients for successful vendor participation in the SI manufacturing markets.

- Appendix A contains an extensive definition of the systems integration delivery mode and contrasts with delivery modes in the information services/technology industry.

C
Methodology

Much of this report's data was gathered from user and vendor surveys during 1993 as part of INPUT's market analysis and systems integration programs. INPUT maintains ongoing relationships with, and a database of, all users and vendors interviewed.

In addition, INPUT's corporate library in Mountain View, California, was used extensively. The resources in this library include on-line periodical databases, subscriptions to a broad range of computer and general business periodicals, continually updated files on more than 3,000 information services vendors, and up-to-date U.S. Department of Commerce publications on industry statistics.

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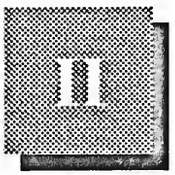

Executive Overview

Although systems integration (SI) as an individual information technology (IT) delivery mode has existed for years, its definition is still evolving.

Over the next five years, the IT industry will evolve into one of more integrated product/services delivery. Systems integrators will offer a major marketing channel for delivery of more complex integrated solutions to the largest available market—large corporations that have traditionally handled their Information Systems development in-house. The complexity of distributed, enterprise-wide solutions create the need for central IS staffs and end-user departments to seek third-party systems integrators to implement these more complex solutions.

INPUT's projected five-year (1993-1998) CAGR for the systems integration market is 14%, compared to its 12% five-year CAGR projection for the total information technology market. However, many systems integrators are significantly broadening their information services to include more systems operations/management, software application/maintenance and professional services, enhancing individual company growth through market penetration of these other high growth IT markets.

Other primary factors driving the systems integration market include:

- Rapid increase in demand for *business process re-engineering*
- Strong demand for *network integration*
- *Increasing confidence in systems integration firms* as potential SI clients see more examples of successful implementation

Vendors in other delivery modes must evaluate partnerships with large systems integrators to market to large corporations that eventually will seek the total solutions provided by single points of contact for development and support.

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A

Definition of Systems Integration Service

Within the scope of INPUT's definition of the information technology (services) industry, there are 10 basic delivery modes (see Appendix A), six of which provide information services. These include equipment services, professional services, systems integration, systems operations, processing services and network services.

Systems integration is traditionally defined as a vendor service that provides a complete (or total) solution to an information system, networking or automation development requirement through custom selection and implementation of various products and services. A systems integrator manages overall the systems integration contract, and is the single point of contact who is responsible for delivering specified system functions to the buyer on schedule at the contracted price.

As indicated in Exhibit II-1, major components of a systems integration project include: *equipment*, which may include custom as well as off-the-shelf equipment to meet the unique needs of a project; *software products,* which can involve prepackaged applications and systems software or custom application development and maintenance; *professional services,* which includes the value-added component that adapts the equipment and develops, assembles or modifies the software to meet the systems requirements; and *other services*, which can include miscellaneous items such as engineering services, business support services and other items required for a smooth development effort.

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EXHIBIT II-1

Products/Services in Systems Integration Projects

Equipment

- Information systems
- Communications

Software Products

- Systems software
- Applications software

Professional Services

- Consulting
  - Feasibility and trade-off studies
  - Selection of equipment, network and software
- Program/project management
- Design/integration
  - System design and re-engineering
  - Installation of equipment, network, and software
  - Demonstration and testing
- Software development
  - Modification of software packages
  - Modification of existing software
  - Custom development of software
- Education/training and documentation
- Systems operations/maintenance

Other Miscellaneous Products/Services

- Site preparation
- Data processing supplies
- Processing/network services
- Data/voice communication services

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Recently the number of companies identifying themselves as systems integrators has expanded significantly. In particular, a number of computer systems, value-added resellers, systems software and professional services companies have expanded their product offerings to include systems integration, greatly increasing the level of SI industry competition. However, only a few large vendors still provide the full range of services and project management skills identified as prime SI contractors.

Many other companies provide primarily professional services and act as subcontractors to large prime systems integration vendors. The key distinction between professional services consulting and systems integration depends on who bears ultimate responsibility for planning and managing a systems installation project. Consulting firms typically provide analytical or technical support as professional services to their clients, seldom bearing responsibility for the result of an implementation project. Systems integrators, in contrast, act as the general contractor on a systems project, assuming project management responsibility and generally bearing some financial risk for the success of the project.

INPUT estimates that there are approximately 30 U.S. Information Services vendors who would currently qualify as prime contractors of systems integration services.

B

Discrete and Process Manufacturing Systems Integration Market Size and Growth Rates

The discrete manufacturing market is the largest commercial systems integration industry-specific market, estimated by INPUT at approximately $1.4 billion in 1992, and expected to grow at a CAGR of 20% over the next five years (1993-1998). The fastest-growing SI industry-specific market is business services, at a CAGR of 23%.

The process manufacturing systems integration market, at $385 million, was approximately 28%, the size of the discrete manufacturing systems integration market in 1992. The process manufacturing systems integration market is projected to expand at a 15% CAGR over the next five years, slightly ahead of the 14% five-year CAGR expected for the total systems integration industry.

The smaller size of the process manufacturing systems integration market reflects the trend in past years for process manufacturers to develop most of their own Information Systems solutions. In large part, this reflects the highly individualized technology solutions required among process manu-

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facturing companies (i.e., food processors and chemical, energy, paper, metals and pharmaceutical manufacturers). In the discrete manufacturing (assembly production) industry, there is much more computer application transference. However, in process manufacturing, the growing sophistication of application development tools allows customization of process manufacturing computer applications on a much more cost-effective basis. Thus, over the past few years, a number of new commercial software products have been introduced for the process manufacturing market, to be utilized by systems integrators.

C

Leading Discrete and Process Manufacturing SI Vendors

INPUT's surveys indicate there are approximately 20 systems integration vendors with meaningful revenues in the discrete systems integration market. The companies with larger market share positions are identified in Exhibit II-2.

EXHIBIT II-2

Leading Vendors in the Discrete Manufacturing Systems Integration Market

- IBM
- Digital Equipment
- EDS
- Andersen Consulting
- Computer Sciences
- Cooper and Lybrand
- Hewlett-Packard
- Groupe Bull
- Computer Task Group
- Systems Applications International Corp.

In the process manufacturing systems integration market, four vendors have been identified as market share leaders, as indicated in Exhibit III-3.

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EXHIBIT II-3

Leading Vendors in the Process Manufacturing Systems Integration Market

- Andersen Consulting
- IBM
- Digital Equipment
- EDS

D
User Requirements and Analysis

INPUT interviews with leading U.S. process and discrete manufacturing vendors were used to determine new systems integration application needs and criteria for selecting third-party systems integration vendors.

Most frequently mentioned new manufacturing SI Application categories were financial, integrated product data management and manufacturing plant floor integration. It is interesting to note that platforms of choice for these systems integration solutions in the manufacturing environment often included a combination of minicomputer and/or mainframe and client/server integration. This suggests that, at this stage of manufacturing application integration, consideration of legacy systems on mainframes and minicomputers is still important.

A follow-up study of manufacturers, including several who had previously indicated an interest in systems integration applications, was also conducted. The most frequently cited specific systems integration projects to be developed over the next three years are included in Exhibit II-4.

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EXHIBIT II-4

Most Frequently Cited Systems Integration Projects Over the Next Three Years (As Cited by Manufacturer Respondents)*

Systems Integration Projects	Percent of Respondents
Client/Server Implementation	88
LAN to LAN Integration	88
Supply Chain Linkage	81
User Training Programs Involving Enterprise-wide Information Access	75
Implementation of an Open Systems Strategy	75
Integration of Islands of Automation	75
Development of Document Management and Workflow Interdepartmental Solution	69

*Multiple responses available

These respondents were also asked to indicate the most important qualifications for a Systems Integration vendor. Specific qualities, ranked in order of importance, are shown in Exhibit II-5.

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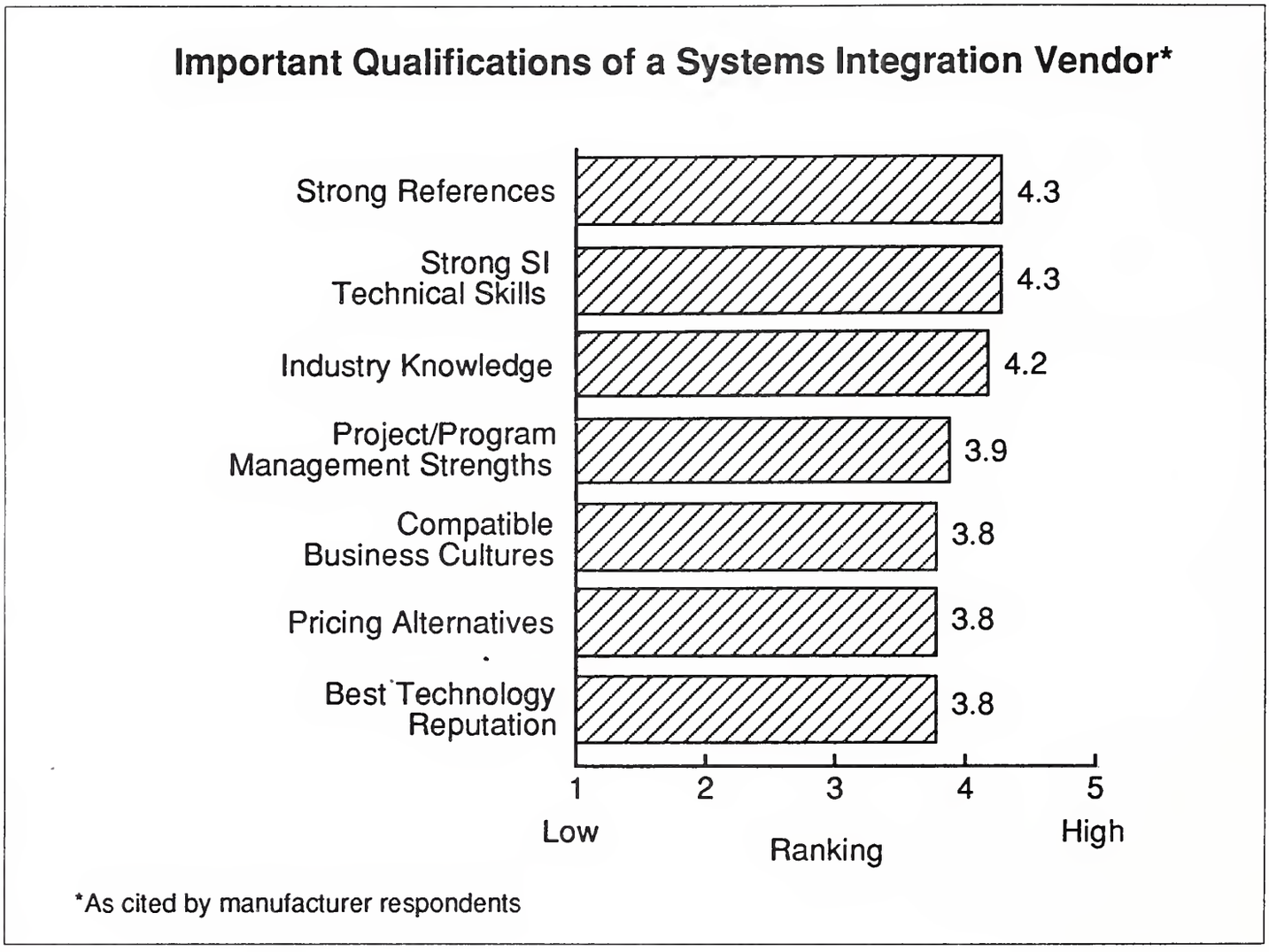
EXHIBIT II-5



E

Keys to Success in Penetrating the Discrete and Process Manufacturing SI Markets

Two principal categories of systems integration vendors appear to have an advantage in what is becoming a much more competitive market, with the more recent market entry of vendors from several information technology delivery modes.

In addressing the needs of large corporations, systems integration vendors who provide a full-service capability, with particular strengths in front-end consulting services such as business process re-engineering and/or in systems management/systems operations, appear to be in a relatively

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stronger position. A key factor to longer-term survival in this industry (with respectable profit margins) is to build long-term business relationships with clients that can lead to contracts for additional types of products and services in subsequent years.

Quality execution and compatible business cultures are other obvious facilitators to achieving long-term relationships. However, another key factor appears to be in assuming the role of a major strategist for the client, taking responsibility for implementation of application development technologies and methodologies as well as defining new business processes for the company. This posture creates a longer-term needs requirement.

Many large manufacturers today appear to be looking for a systems integrator to take over systems/operations management of particular business units on an outsourcing basis. Outsourcing improves the return on investment for particular business units by utilizing an outsourcing technology business partner over a longer period of time. Leading outsourcing vendors frequently describe new contract wins as a combination of systems integration/systems management-type solutions.

Another successful vendor profile is the systems integrator that targets specific projects within a company with its in-depth knowledge of particular industries. These contracts can be viewed more as professional services contracts, but they can also be classified as systems integration contracts *if* the vendor assumes most of the responsibility (and risk) for successful conclusion of the project. Long-term business relationships are also key to the success of this type of systems integration contract. Such relationships could include long-term maintenance and upgrade of particular application areas for a manufacturer.

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Overall, INPUT surveys indicate that recently successful SI vendor contract wins are based on a combination of vendor technical excellence, competitive pricing, industry track record, partnership commitment and a global presence. (See Exhibit II-6)

EXHIBIT II-6

SI Vendor Contract Win Factors*

Factor	Percent of Responses
Technical Excellence	31
Competitive Price	23
Full Services/BPR Capabilities	15
Industry Track Record	15
Partnership Commitment	15
Global Infrastructure	15
Best Value	8
Cultural Fit	8
Specific Business Knowledge	8
Tangible Benefits To Customer	8

*Multiple responses available

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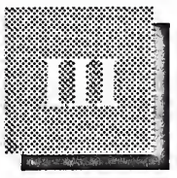

User Requirements and Analysis

A
Analysis of INPUT's New Applications Opportunity Database

INPUT recently surveyed several hundred corporate users across all major industry-specific markets (defined by SIC code) about their future information systems applications development planning. Of the nearly 2,000 planned applications cited, approximately 32% represented systems integration and/or professional services solutions. The need for professional services applications was significantly higher than for systems integration. Of the applications mentioned involving professional services and/or systems integration, approximately 26% were specifically identified as systems integration solutions.

Twenty-two percent of the total new applications identified in INPUT's survey were from the discrete and 20% from the process manufacturing industry sectors. Interestingly, the percentage of new applications (14%) involving systems integration/professional services in the discrete and process manufacturing industries, was among the largest of all vertical industries. This might reflect the fact that these industries were among the early adopters of systems integration solutions.

The industry sectors showing the highest percentage of planned SI applications were retail trade, business services, state and local government and telecommunications.

However, the total size of the discrete and manufacturing information services markets would suggest that the absolute number of SI applications opportunities is large relative to the other industry-specific markets.

Exhibit III-1 shows distribution of platform choices for discrete and/or process manufacturing future applications by respondents citing discrete and/or process SI type applications needs.

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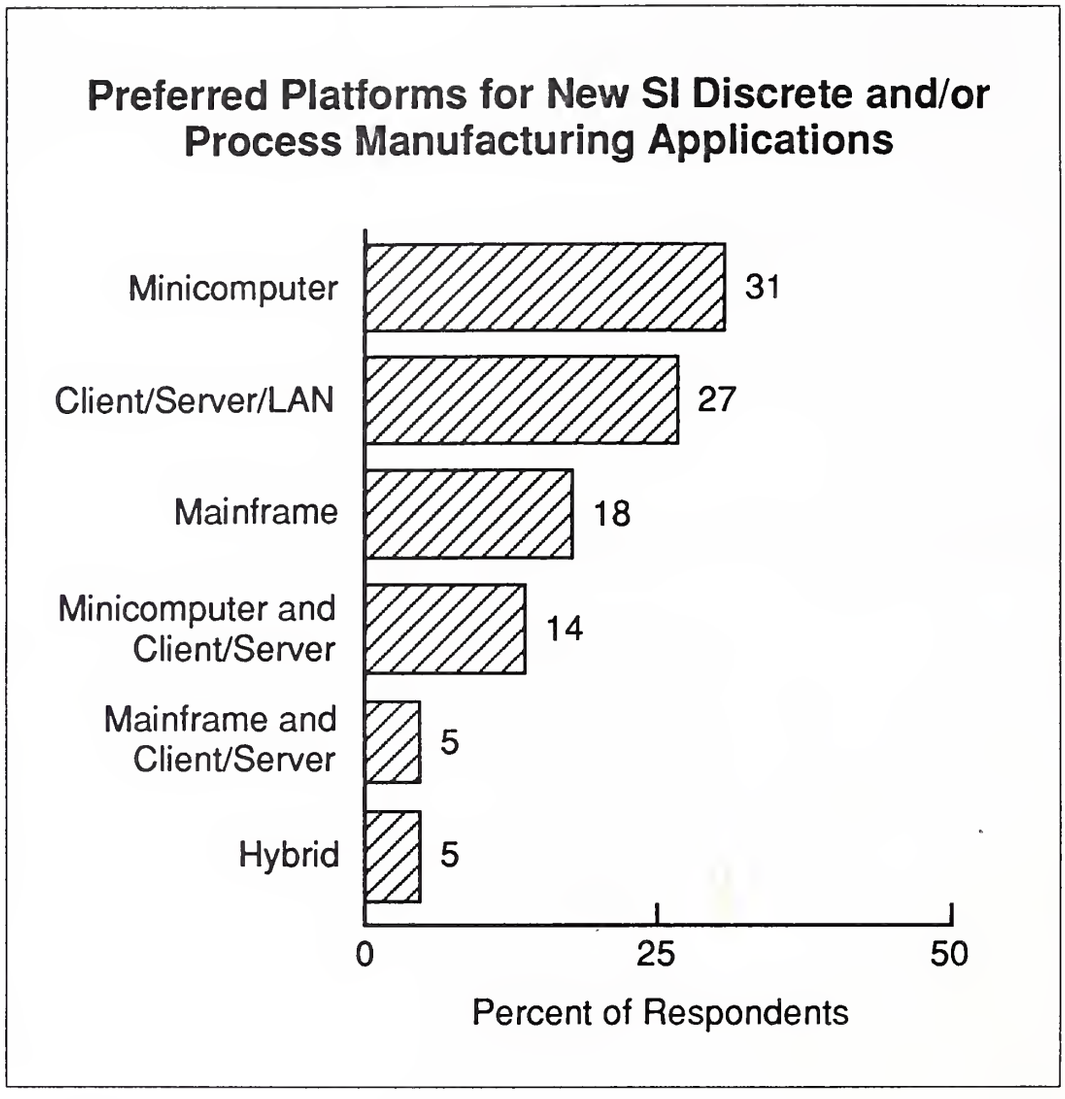
EXHIBIT III-1



The most frequently mentioned applications categories indicated by respondents with specific systems integration solutions needs are included in Exhibit III-2.

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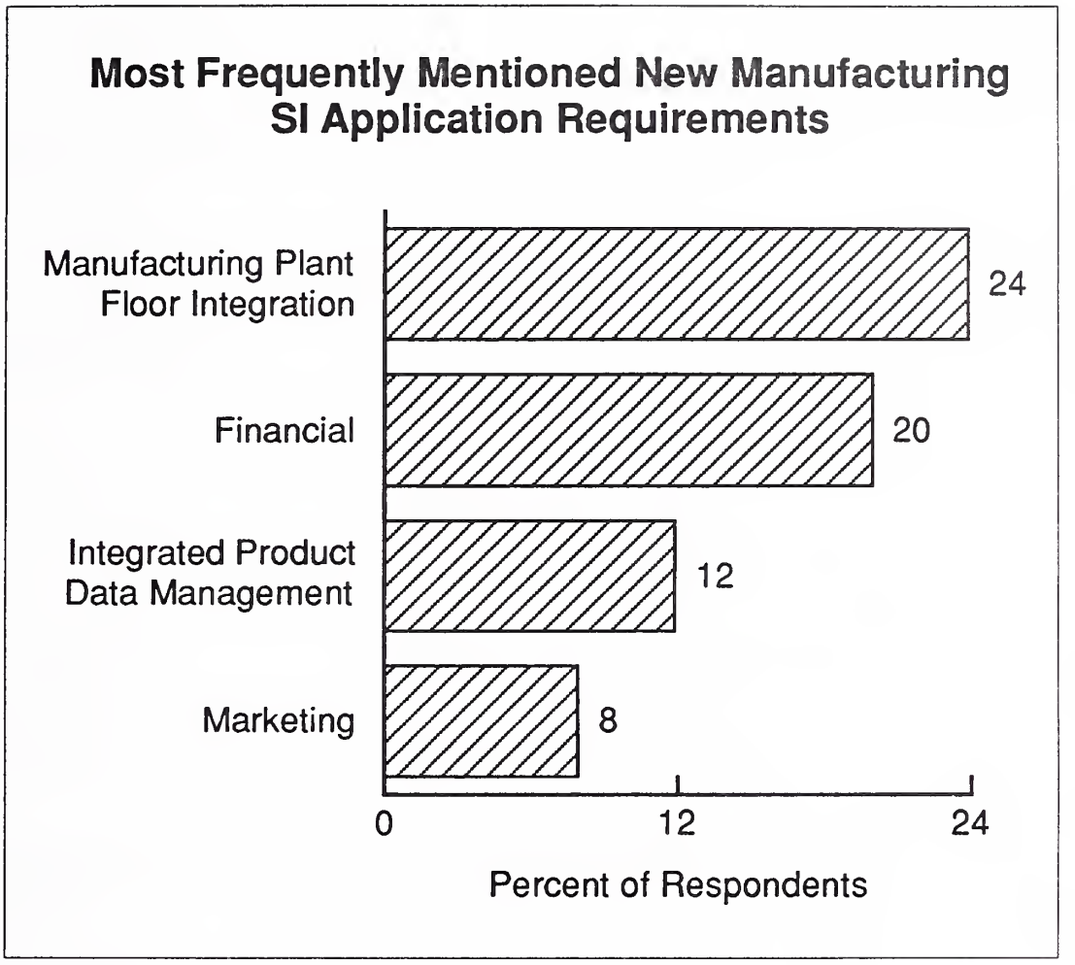
EXHIBIT III-2



Platforms of choice, (among respondents), for new systems integration applications in the manufacturing sector suggests that integrating legacy systems with mainframe and minicomputers is still very important, as opposed to a major conversion to client/server architectural solutions.

INPUT's larger, multi-industry survey was heavily skewed toward individuals with divisional IS responsibility. Of the approximately 2,000 new applications identified in this user survey, 65% were from program managers of a user division. It is important for systems integrators to recognize the recent shift within corporations in terms of responsibility for new computer applications. Much of the decision making now involves much more end-user departmental input and more corporate CFO and CEO involvement than in the past.

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B
User Needs Analysis

INPUT did a follow-up study to the initial large survey of vendors in the discrete and manufacturing industries, targeting mid- to large-sized U.S. manufacturers (some of whom were identified in the initial 1993 survey), regarding their particular systems integration application needs. Larger manufacturers were targeted because INPUT's study of the systems integrations market shows that, at this stage, larger companies more often tend to use third-party systems integrators.

Respondents included companies from both discrete and process manufacturing industries, with no particular concentration in any manufacturing subsector.

This second study also identified applications involving systems integration that were to be implemented over the next three years. In addition, respondents were asked to identify computer technologies of current interest, their intended usage of a third-party systems integrator and the criteria they used for selecting a system integration vendor.

1. Relative Importance of Manufacturing Information Technology

Exhibit III-3 shows on a scale of relative importance which information technologies were ranked highest by respondents, in terms of their *current* interest. (The total list of technology choices is in the survey Questionnaire in Appendix B of this report.)

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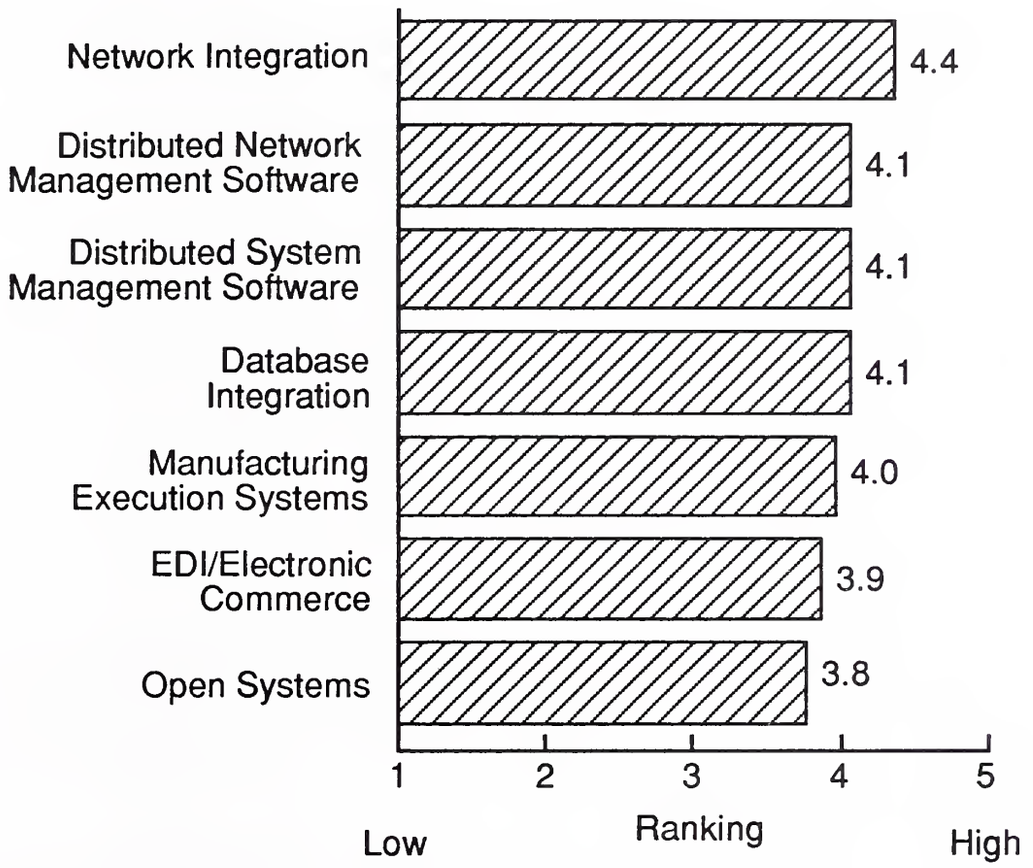
EXHIBIT III-3

Important Systems Integration-Related Information Technologies*



*As identified by survey respondents

Exhibit III-4 identifies those technologies considered least important at this stage of new application development.

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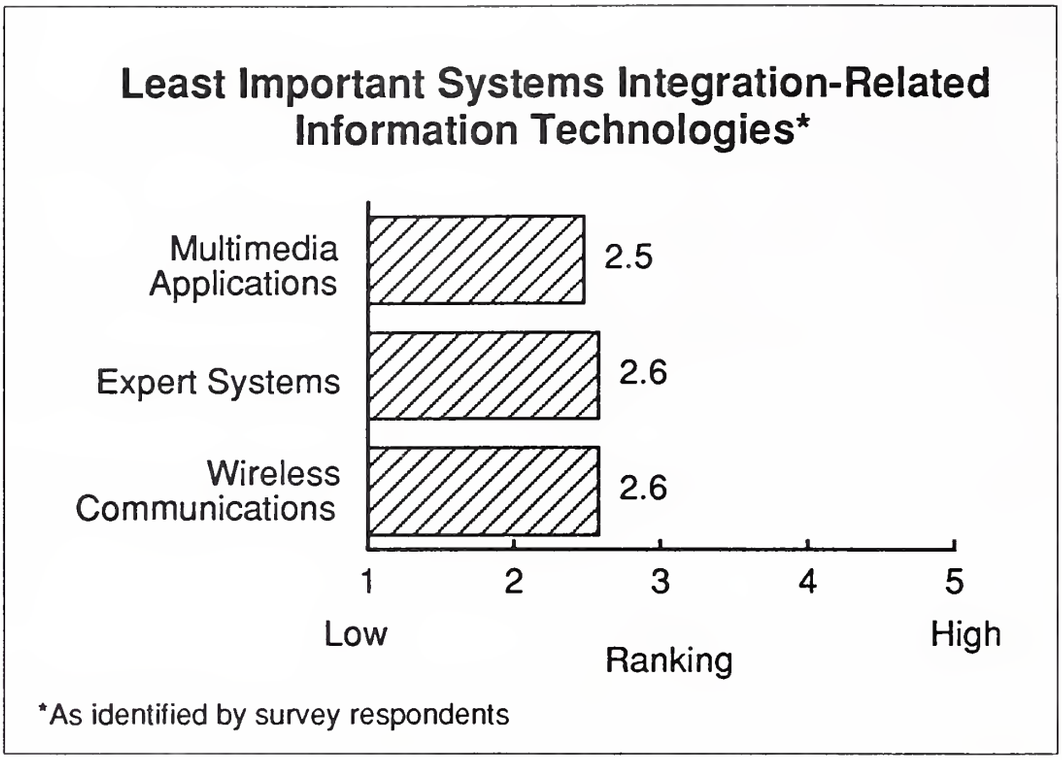
EXHIBIT III-4



Some of the "hottest" new technologies, as identified by the general media, were identified among the lowest for current interest. This suggests that companies are still at the more basic level of integration requirements—such as putting together an integrated corporate network of information resources.

2. Planned SI Applications Involving Internal or External SI Resources

Respondents were asked to choose from a list of applications those they are planning to implement over the next three years, which could involve either an internal or external systems integration resource. Multiple applications were usually selected by each respondent.

Exhibit III-5 shows the most frequently mentioned systems integration applications.

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EXHIBIT III-5

Most Frequently Cited Systems Integration Projects for Implementation in the Next Three Years*

SI Application	Percent of Respondents
Client/Server Implementation	88
LAN to LAN Integration	88
Supply Chain Linkage	81
User Training Programs Involving Enterprise-wide Information Access	75
Implementation of Open Systems Strategy	75
Integration of Islands of Automation	75
Development of a Document Management/ Workflow Interdepartmental Solution	69

* As cited by manufacturer respondents

Note: Multiple choices are possible

The highest level of systems integration activity among the respondents will be in client/server implementing, integration of local area networks and supply chain linkage.

Systems integration vendors surveyed by INPUT also emphasized strong growth in current and projected client/server systems integration projects. One vendor indicated an expectation of a doubling in revenues in 1993 (primarily as a result of client/server systems integration projects) from a $1 billion base in 1992.

The systems integration application of least interest was a life-cycle environmental impact analysis, with only 13% of respondents planning to implement such a solution over the next three years.

3. Use of Outside Systems Integrators to Implement Planned Systems Integration Programs

Manufacturers surveyed were told that a principal use of the study was to help systems integration vendors determine systems integration needs of potential clients. In addition, many companies selected for the survey had indicated in an earlier INPUT survey that they planned to implement at least one systems integration project over the near term. As such, many that responded had a probable predisposition toward the possible use of a

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third-party systems integrator. Seventy-five percent of respondents indicated they would consider using a systems integration vendor to implement the projects they had identified as incorporating some element of systems integration.

Principal reasons identified for using a third-party systems integrator were:

- Pressing deadlines, and the company's lack of in-house expertise.
- To develop partnerships with vendors to guarantee the best possible implementations.
- To minimize IS staff in the future and use highly regarded systems integrators to support internal staff to levels required for project implementation.
- To gain experience from the lessons learned—by outside systems integrators in a particular industry or technology.
- For funding support of the project.

Manufacturers who showed no interest in using systems integration vendors either were not yet ready for such services or believed they had the strategic direction and skills to implement the projects themselves.

4. Criteria for Choosing an Outside Systems Integrator

Two broad sets of criteria for selecting a systems integration vendor were presented. The first set dealt with capabilities of the vendor. The second set dealt with pricing issues.

Exhibit III-6 prioritizes users' criteria for selecting a systems integrator based on technical, industry and funding capabilities.

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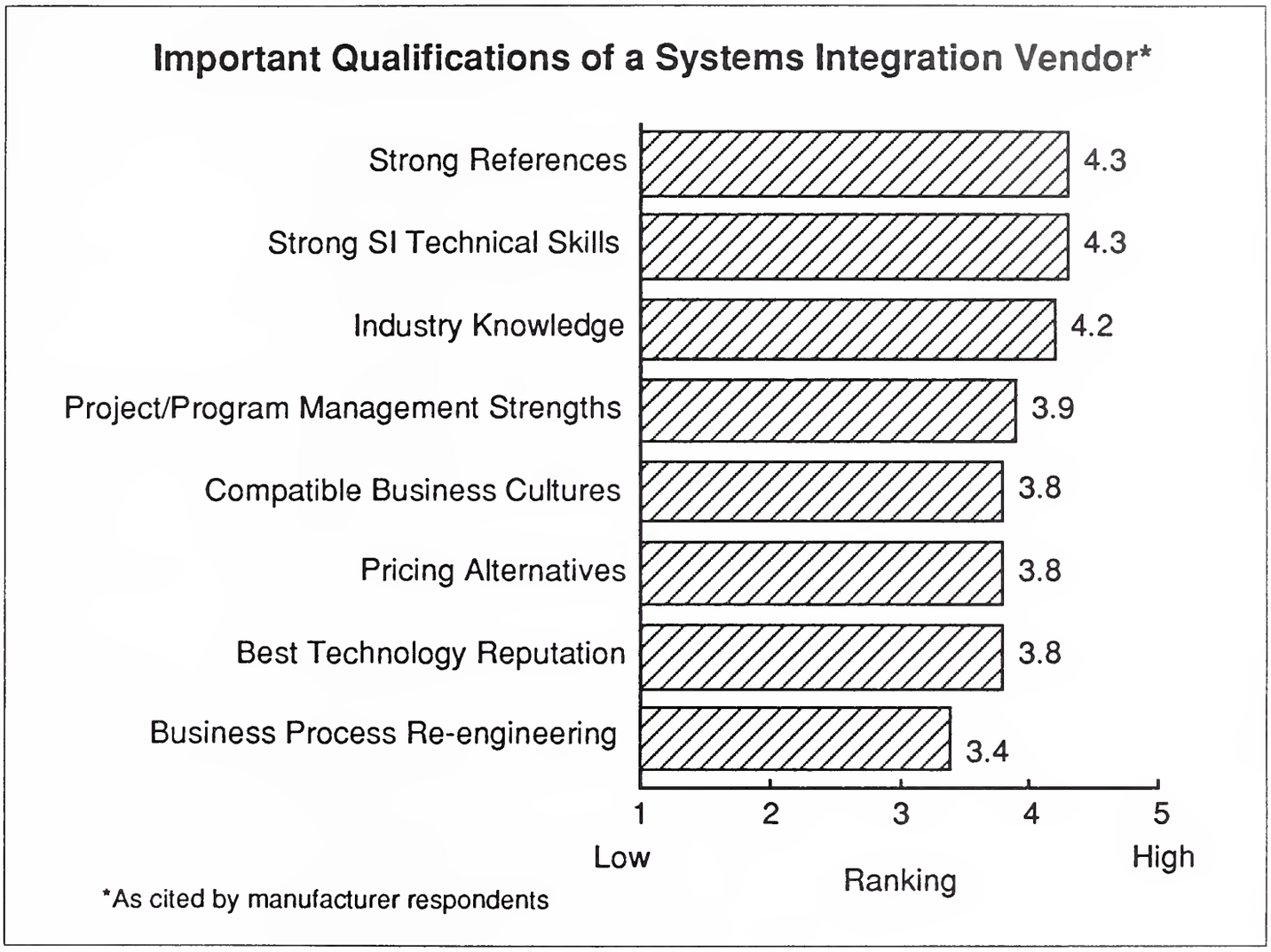
EXHIBIT III-6



Highly regarded systems integrators are those have reputations for strong industry knowledge, as well as key technology skills.

Business process re-engineering interest appears to be concentrated in the more troubled industries and with larger corporations. Also, business process re-engineering tends to be a more specialized skill set of certain systems integration vendors, particularly those with strengths in strategic consulting services. Of interest, also are attributes of least importance (as indicated in Exhibit III-7) to prospective clients, in terms of systems integrators' capabilities.

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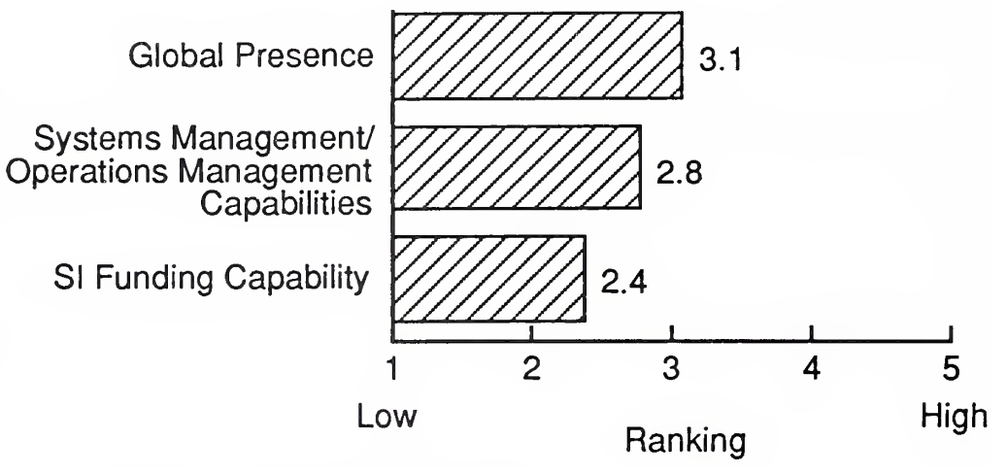
EXHIBIT III-7



The lower ranking of systems management/operations management capabilities suggests this activity is in the early stages of being identified as a systems integration component, and it also tends to be a specialty of a particular group of systems integrators.

5. Client Preferences for Systems Integration Vendor Pricing

Manufacturing companies showed a preference for fixed priced contracts, with the incorporation of performance clauses, as indicated in Exhibit III-8. The relatively high ranking of fixed price contracts (as opposed to cost-plus services) reflects that this was a user survey, where a fixed-cost contract provides some protection from the financial risk of a cost-plus contract.

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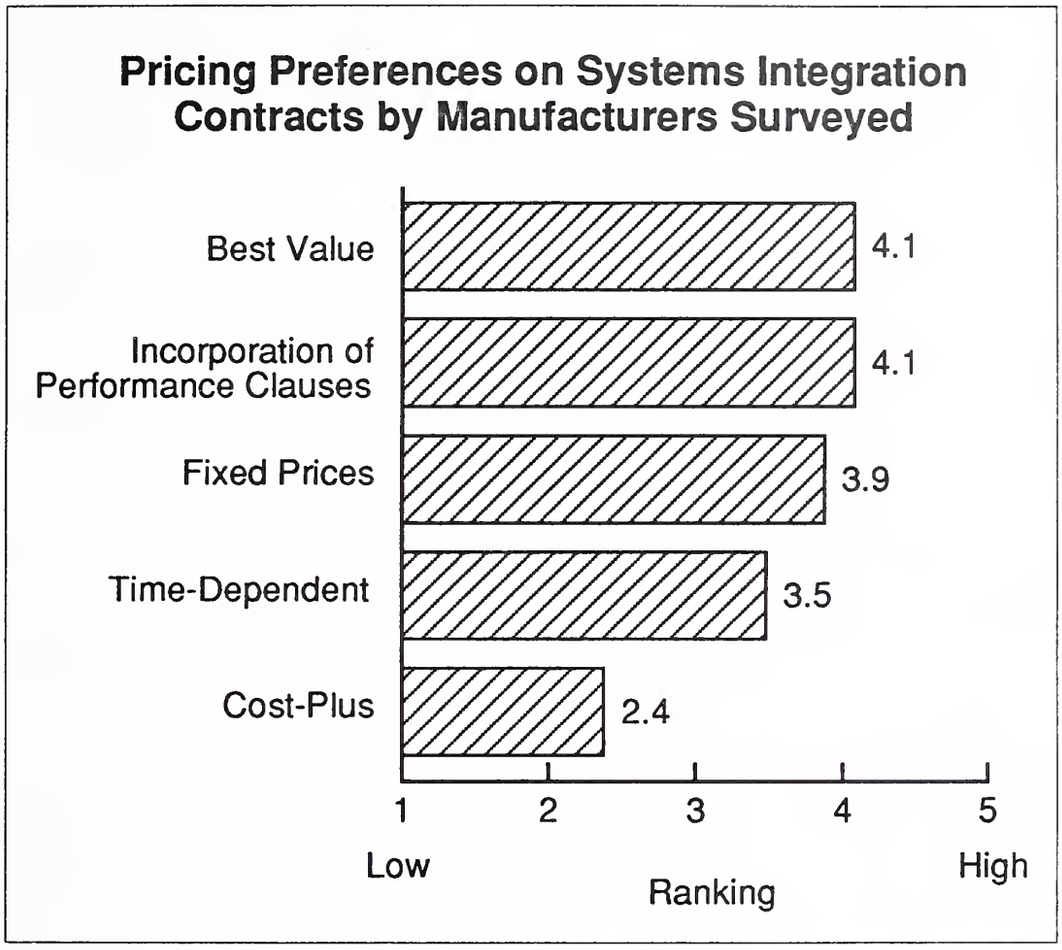
EXHIBIT III-8



Cost-plus contracts ranked lowest by user respondents, which is another way of showing they want to avoid the financial risks of an open-ended contract. Under a fixed-price contract, the vendor is rewarded for performance at or below the targeted budget. However, an incentive-based contract for a vendor is the cost-plus contract, where the user pays for the actual costs, which explains the low ranking by users for cost-plus contracts. However, an issue for vendors is that profit margins are considered proprietary information and arming customers with this information can let them determine how much a vendor earns.

INPUT found that the more frequently used industry SI contract options in the discrete and process manufacturing industries are fixed price with penalties and awards, and fixed price with escalation clauses. Based on vendors' responses, cost-plus contracts are applied the least across the vertical industries, with the exception of government sectors.

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6. Current Profile of Systems Integration Product/Services Delivery in the Manufacturing Sector

a. General Pricing Strategies of SI Vendors

A relatively recent survey on overall pricing strategies of SI vendors across a number of vertical industries also indicates an emphasis on "best cost/best value" alternative pricing. There also appears to be decreasing emphasis on charging a premium for quality services.

This data suggests that with increasing competition in the Systems Integration industry, cost/price to the customer plays a more active role in SI negotiations. Although customers may request the best business practice solutions and value-added services from vendors, they are not paying higher prices.

This does not imply that today's market requires vendors to offer the lowest-cost alternative, but that price sensitivity issues are a stronger force in today's SI market.

Vendors are not sacrificing quality of work in this more intensely competitive environment, but they are getting more efficient at how they deliver services, with technological improvements and proven methodologies, which help control customer costs.

No one pricing strategy is generally applicable to a specific industry or across the board. The scope of the proposed SI venture determines pricing. Several factors combine to influence how a job is priced for each potential customer:

- Project complexity
- Project size/volume/length
- Partnership dimensions
- Schedule constraints
- Project risk

Pricing strategies must be flexible to accommodate variances in technical and managerial complexity. Complex projects bring an associated higher value to a contract, provided the return on investment to the customer is also high, especially in providing mission-critical applications solutions. A contract that specifies a large volume of services will probably lower the vendor's overall costs of providing service to the customer. These

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savings can be passed on to the customer. A long-term contract promises less financial risk in terms of underutilized staff and personnel. These savings often translate into a better price for the customer. A project on a tight schedule means higher prices.

The extent of the business partnership commitment between vendor and customer also affects pricing. If the vendor assumes more risks associated with completing an SI project, higher costs are passed on to the customer. On the other hand, in a true partnership arrangement, the customer is actively involved in the SI process and takes on some of the necessary steps to ensure that the solution will be accepted operationally within the enterprise. Sharing responsibility with the vendor places another dimension on overall price that can be beneficial is the customer.

SI vendors were also asked how they foresee their pricing strategies changing over the next five years. Approximately one-third of the respondents saw no change in their pricing strategies. A little more than one-third indicated they expected to include more of a total solutions focus, providing not only more value-added services but a greater breadth of services. The remaining respondents indicated change would be customer-driven or would involve lowering their costs, including more risk-sharing contracts between client and vendor.

In general, across-the-board pricing is not practiced in the systems integration industry. The price a customer pays is based on individual negotiations with the vendor.

b. General SI Vendor Trends

i. Changing Definition of the Systems Integration Delivery Modes

The systems integration delivery mode of information services is an outgrowth of the professional services delivery mode. In addition, definition of the systems integration delivery mode evolves continually.

At one time, client need focused more on consultation and implementation than on integration. With increasing intricacy of business needs and increasing complexity of changing technology, many of the larger SI vendors in recent years have expanded their "systems integration" services to include a full array of Information Technology, shown in Exhibit III-9.

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EXHIBIT III-9

Continuum of Vendor SI Services

Total Project Management	Consulting	Process feasibility and trade-off studies Business process re-engineering and systems design
	Selection	Selection/configuration of equipment and networks Selection of systems software Selection/development of applications software
	Implementation	Change management Installation of equipment and software Testing and demonstration of system System acceptance Documentation Client staff training
	Ongoing Support	Systems operations Maintenance of equipment and software Financing

Recent value-added services now asked of SI contractors include performing the roles of Business Redesigner, Technology Facilitator, Change Manager, and Business Consultant. In addition, larger companies in systems management/systems operation markets are moving more into the systems integration industry. Leaders in the systems operations market indicate that many of their more recent contracts include systems integration features. In addition, companies that were originally leading providers of front-end consulting and business re-engineering services are also moving into systems operations.

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The role of technology facilitator is demanded by a broader spectrum of systems integration providers. Users find keeping up with evolving technology and managing multivendor environments is far too complex and resource-intensive. In addition, client/server and desktop operating environments create further complexity issues. Users, overwhelmed by tasks of applying rapidly changing technology and managing new environments, rely more on their contractors to act as technology consultants.

Demands of business process re-engineering (BPR) vary considerably by industry. More companies in manufacturing, wholesale and finance sectors and in government entities, particularly defense agencies, want SI contractors to function as business redesigners.

If SI contractors perform BPR and SI services, they will also manage the change process to ensure successful completion of the project. Vendors describe change management as the responsibility for supporting technological, educational, and organizational changes associated with BPR changes. This role continues until the changes are established within the organization.

In the past, SI contractors only provided training services for their newly developed systems. Because of BPR, the concept of education and training is greatly expanded and now entails enterprise-wide management and training services.

ii. Strategic Partnering

Usually, systems integration vendors do not provide the total systems integration product and services solution from their own resources. In the manufacturing sector, some of the largest vendors can provide much of the total systems integration solution as a single vendor. However, the amount of strategic partnering in the industry is accelerating. In particular, computer systems companies and systems and applications software product companies realize the systems integration delivery channel will be one of the healthiest for their product over the next several years.

iii. Bifurcation of Successful Strategies Between Small and Large Vendors

New entrants into the systems integration market in recent years have identified a success pattern, which includes participation of smaller vendors who target specific systems integration tasks within specific industries; large companies that have established the "success cache," and the true full-service systems integrators. With considerable industry consolidation anticipated over the next few years, there could be a shakeout in the middle tier of vendors.

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Application development tool capabilities are becoming increasingly important. Many major systems integration vendors are developing very sophisticated value-added application development frameworks, which can greatly ease the development of distributed (integrated) applications, as well as help reduce longer-term maintenance costs.

Successful SI vendors continue to obtain new business from their customer bases over a long period of time. A particular aid to this approach to long-term relationships is strength in business process re-engineering, where the consultant provides advice in business process change and builds SI solutions that incorporate the new business rules and processes they have designed. With the trend to longer-term enterprise-wide solutions, it is frequently most cost-effective for the customer to use the same vendor to implement changes in business procedures throughout the enterprise.

To date, even large SI vendors do not yet see a strong interest in truly enterprise-wide solutions. However, interdepartmental, networked solutions, based on client/server technology, represent major contract growth opportunities.

SI vendors also stress open systems solutions, and UNIX appears to be increasing in popularity in many industries, including manufacturing.

To reduce the cost of applications solutions development, some systems integrators have developed "template"-based solutions for particular industries. They also use strategic industry partners to help provide certain "standardized" solutions for parts of a total systems integration solution.

Larger SI vendors, including many who address manufacturing SI sectors, created value-added applications and systems software frameworks to facilitate the development of solutions that integrate islands of automation within the manufacturing enterprise. Much of the systems software part of the solution can be included in middleware.

Many leading SI vendors in the manufacturing industry work with object-oriented programming tools. This technology also provides a migration path towards distributed (client/server) solutions. Applications are broken into modules and then can be transferred a module at a time from mainframes to smaller platforms.

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Software vendors who address manufacturing markets, and intend to work with systems integrators, must become very knowledgeable on object-oriented development technologies. SI vendors are beginning to utilize packaged software solutions in various modularized solutions, connected by object-based technology.

Document management/work-flow tools are increasingly used to connect departments, while special database architectures create integrated access across diverse architectures.

EDI technology capability is becoming increasingly important to SI vendors in the manufacturing sector as a means of addressing increasing manufacturer interest in improving efficiency of the supply chain linkage. This is particularly important in the automotive industry, which connects small to midsized suppliers to the manufacturer and dealers to manufacturers. This is also true in the pharmaceutical industry, where electronic linkages help speed up clinical studies and FDA approval processes.

iv. Recent Larger SI Contracts in the Manufacturing Markets

INPUT's compilation of the larger SI contracts (by vendor) in manufacturing markets over the past two years includes:

EDS:	Allied Signal, Bethlehem Steel, Del Monte, Memorex Telex, British Petroleum Exploration, Mitsubishi, Dupont Polymer Group, E. Wedel SA, Lagoven, SA, Hadson Gas Systems, Detroit Diesel, General Motors.
DEC:	British Aerospace, Caterpillar, AMP, James River Corp.
IBM:	Caterpillar, Burroughs Wellcome.
Andersen Consulting:	Royal Dutch Shell, Hercules, BASF, Astra-Merck.
Computer Sciences:	Rockwell International, Boise Cascade.

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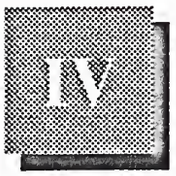

Discrete and Process Manufacturing Trends and Issues

A
Overview

Historically, the Discrete Manufacturing Information Services Market has been more than twice as large as the Process Manufacturing Services Market. This reflects that Process Manufacturing (which includes consumer nondurables, such as pharmaceutical and food processing companies, as well as metals, chemicals and energy industries) requires highly specific solutions tailored to particular manufacturing processes.

Until five years ago, many third-party manufacturing information services providers of "standard" solutions focused on the discrete manufacturing world because it was easier to transfer applications between specific discrete manufacturing sectors.

This changed considerably with the advent of new application development tools, such as 4GLs/CASE and object-oriented development techniques that ease software customization, thus accommodating diverse manufacturing environments, including transferability of discrete applications to hybrid (discrete and process) manufacturing environments. Some of the fastest growth software product markets have been MRPII and MES (Manufacturing Execution Systems) applications software that address the process manufacturing markets.

The process manufacturer's diversity of needs, however, has been a boon to systems integration and professional services providers. For many process industry segments, SI vendor-provided business process systems integration frameworks effectively address major needs of single software products vendors by integrating the following functional areas: order entry, materials planning, product design, process design, production process and the customer delivery life cycle.

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Systems integrators ease the applications integration process from significant custom coding to using open systems architectures (with object-oriented technology) that helps eliminate incompatibility of manufacturing systems—from the shop floor to product design and business application management. It also allows modularization of software components, so best-of-breed software products of various vendors can be more easily reconfigured into an optimal total solution.

Some of the best-known integrated product solutions are: ITP Boston Inc.'s Mainstream; IBM's Distributed Automation Edition and Process Operations Management System (POM); H-P's Industrial Precision Tools; and DEC's BaseStar and FBE (Framework Based Environment). Such platform frameworks use standard interfaces upon which additional solutions can be built to help minimize new product development and training costs.

B

Leading Edge Manufacturing Application Trends

Some of the key application and systems software product trends shaping systems integration programs in the manufacturing environment, both process and discrete, include:

- *Manufacturing planning tools* for integrating design engineering and production activities. Andersen Consulting labels its new product in this area as Computer Aided Process Planning (CAPP/D), which is an addition to its MAC-PAC/D manufacturing software product line.

- *Project management software* used to develop enterprise-wide solutions, which allows changes in any one application area to be incorporated into process/data management changes in related, integrated applications. These also allow programming to include company-specific business rules or procedures in the management change process.

- *Product data management systems* (for the manufacturing environment), such as Structural Dynamics Research Company's DCMS; H-P's Project Management Control System; and IBM's Product Data Manager. These data management systems can include integrated (through common programming interfaces) application development tools in electronic design analysis, manufacturing process planning, enterprise master scheduling tools and common computer graphics user interfaces.

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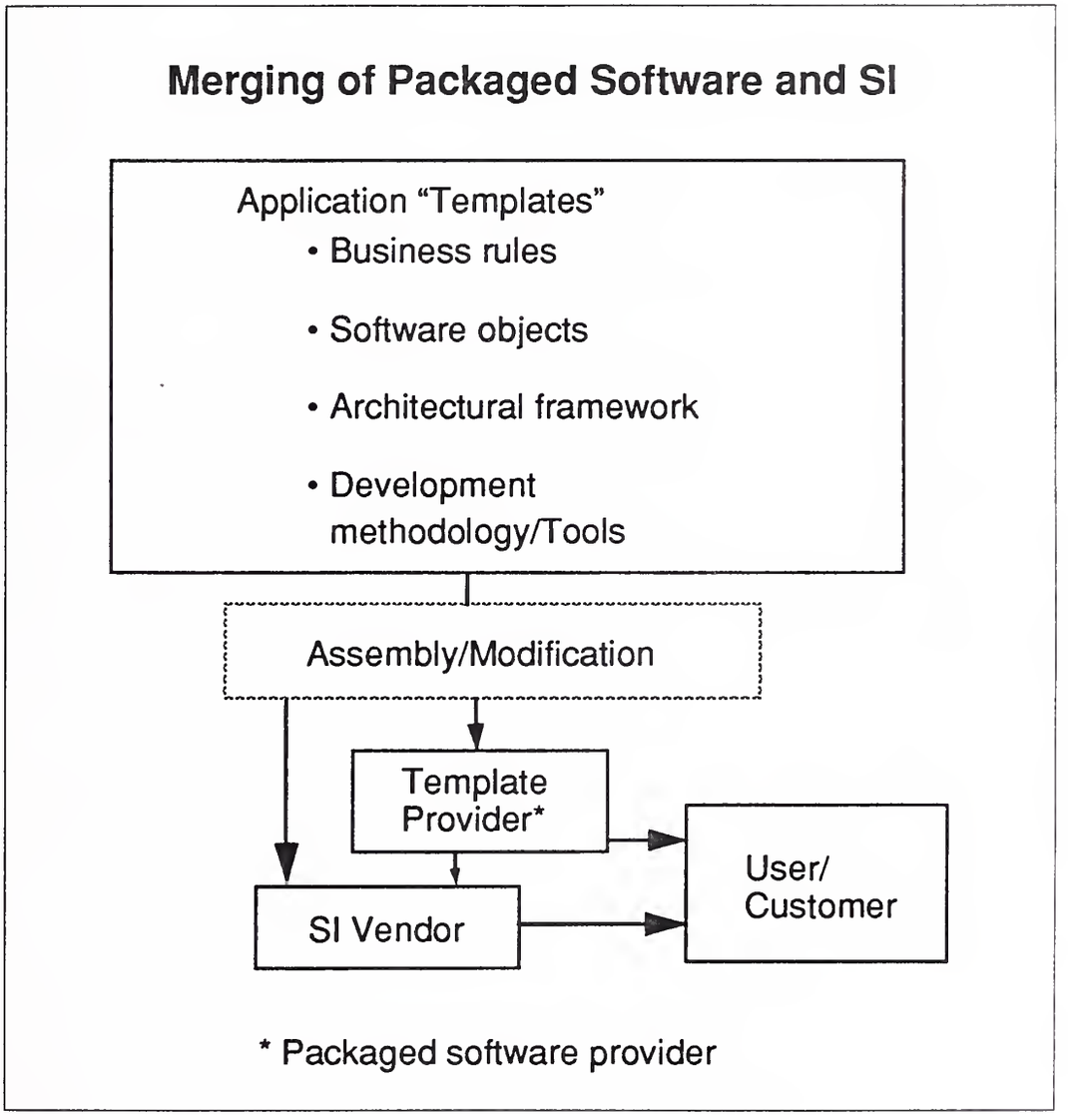
- *Template solutions* (highly customizable), often with partners who provide specific industry expertise to increase application development speed and reduce the development and maintenance costs. For reusability and ease of customization, many of these solutions are developed based on object-oriented, 4GL and CASE application development tools, common architectural frameworks and incorporate business rules which can combine a vendor's industry knowledge with a client's particular business process requirements. As indicated in Exhibit IV-1, often the template development involves the strategic partnering of SI vendors with software product vendors.

EXHIBIT IV-1



- *Non-procedural application development tools,* such as 4GL, CASE and object-based application development tools, which eases product development and costs of product modules.

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- New generation of *Manufacturing Resource Planning* (MRPII) software known as *ERP* (Enterprise Resource Planning), which addresses a broader class of manufacturing planning issues.

- *Manufacturing Execution Systems* (MES), which connect shop floor data with business planning data for two-way production planning and support.

- *Customer-Oriented Manufacturing Systems* (COMMS), as defined by Advanced Manufacturing Resources, which provide a technology framework focused on response to customer needs.

- *Virtual corporate technology solutions*, involving EDI/Electronic Commerce to integrate suppliers and customers into the CIM linkage, which eventually leads to more extensive global linkages.

- *Multimedia-based integrated applications* , in an early development phase; however, document management and work-flow applications show rapid growth.

- *Acceleration in strategic partnering* among companies specializing in software products, systems integration, professional services and computer systems, to provide longer-term development for enterprise-wide (total solutions) applications.

Much of the material in Section C is extracted from INPUT's Discrete and Manufacturing Reports issued in 1993 as part of its Market Analysis Program (MAP).

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C
Discrete Manufacturing

1. General Overview

Typically a purely discrete manufacturing operation is one of assembly; the basic form of the components does not change as a result of that assembly.

Business practices incorporating Total Quality Management (TQM) principles blur the lines between discrete and process definitions. The desire to utilize concepts of continuous flow, flexible manufacturing, process control, 100% quality, 100% service, reduced cycle times and increased customer responsiveness reflects a blending of the best of process and discrete practices.

Implementing TQM principles and computer-integrated-manufacturing (CIM) elements can bring about a new company structure, often referred to as business re-engineering. Portions of that change include:

- Cellular structure and the team approach to continuous improvement.
- Building relationships with outsourcers, professional services, and systems integration vendors in information services delivery, partnering for manufacturing operations and purchasing services and materials.
- Much greater technology and business services focus on the user of the manufacturing technology as well as on improving customer service interfaces.

Restructuring occurs on a large scale throughout discrete manufacturing companies. Although it has many elements, the major factors are listed in Exhibit IV-2.

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EXHIBIT IV-2

Discrete Manufacturing

Facets of Re-engineering

- Team assignments to perform complete operations, typically called "focused cells"
- Worker empowerment, moving decisions to the lowest possible level
- Continuous improvement in terms of:
  - Shortening all cycles in the business operations
  - Work towards achieving 100% acceptable quality in all processes and products
  - 100% customer satisfaction
- Responsiveness to total market and individual customer needs
- Streamlining to perform only in a company's area of expertise

Restructuring through re-engineering has also changed the decision-support structure in many discrete manufacturing environments, from the traditional hierarchical structure to one based on focused cell groups where individual workers within individual cellular structures gained more decision power as well as accountability for particular processes, including product quality and customer satisfaction. See Exhibit IV-3.

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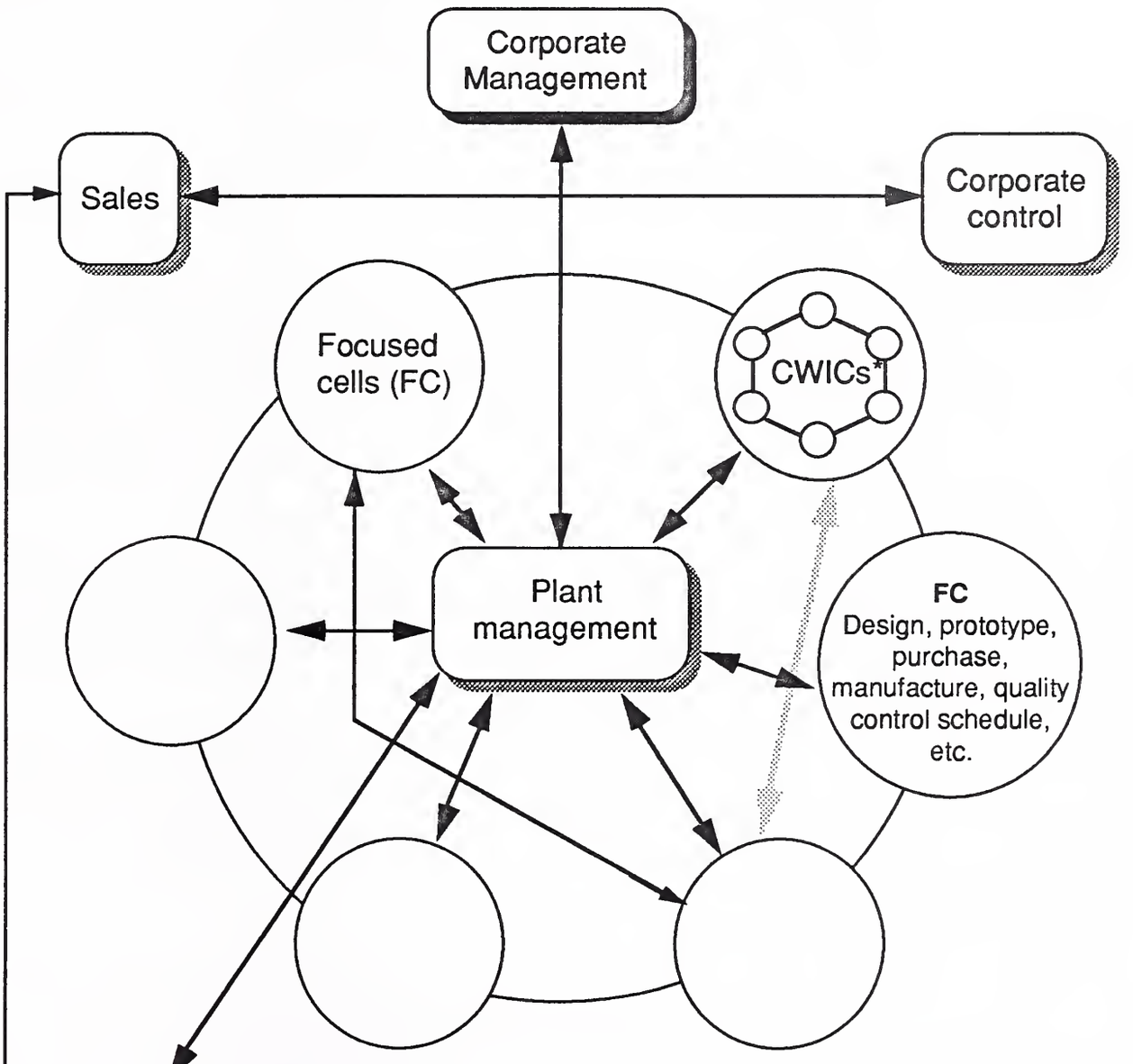
EXHIBIT IV-3

Re-engineered Structure



All functions are responsible individually and collectively for "customer service" levels of 100%. A customer can be either internal or external

*CWIC is "cells within a cell", where workload and diversity of assignments may call for further quality control and responsibility

Each focused cell has total responsibility for the completion of its operation, from design to movement out of the cell!

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As worker involvement and the team approach succeed, benefits to companies are becoming evident in terms of continuous improvements:

- Product life cycles are shortening dramatically, so "time to market" for new products is keeping pace with the change.
- Order-receipt-to-shipping cycles have been reduced.
- Quality improvements reports are very encouraging.
- Cycle reductions and improved quality are leading to improved customer satisfaction.

With restructuring, businesses have streamlined (downsized) with a positive effect on overall performance. Companies have outsourced operations that don't fit within normal practices. Professional services and systems integration projects are contracted out more frequently because new information technology resources are required for many of the newer programs; companies want to learn from the experiences of others in their industries, as well as save money on large or complex projects.

A change in regulation for discrete manufacturers is the movement toward self-regulation. In order to sell to many larger companies, it will be necessary to demonstrate a willingness to implement the new TQM practices.

The entire European community will require conformance to ISO 9000 standards in the near future. Performance levels required to meet expectations will force more companies to re-engineer and incorporate TQM principles, leading to greater automation and CIM techniques.

2. Information Technology Trends

As business re-engineering occurs, the role of the information systems department becomes one of facilitation and/or education rather than operations. The downsizing or client/server approach to processing, storing and moving information often causes a transfer of some or all of IS budgets to end-user departments. This trend toward client/server environments is caused partly by cost reduction programs and partly by a need for information services to match emerging new business structures.

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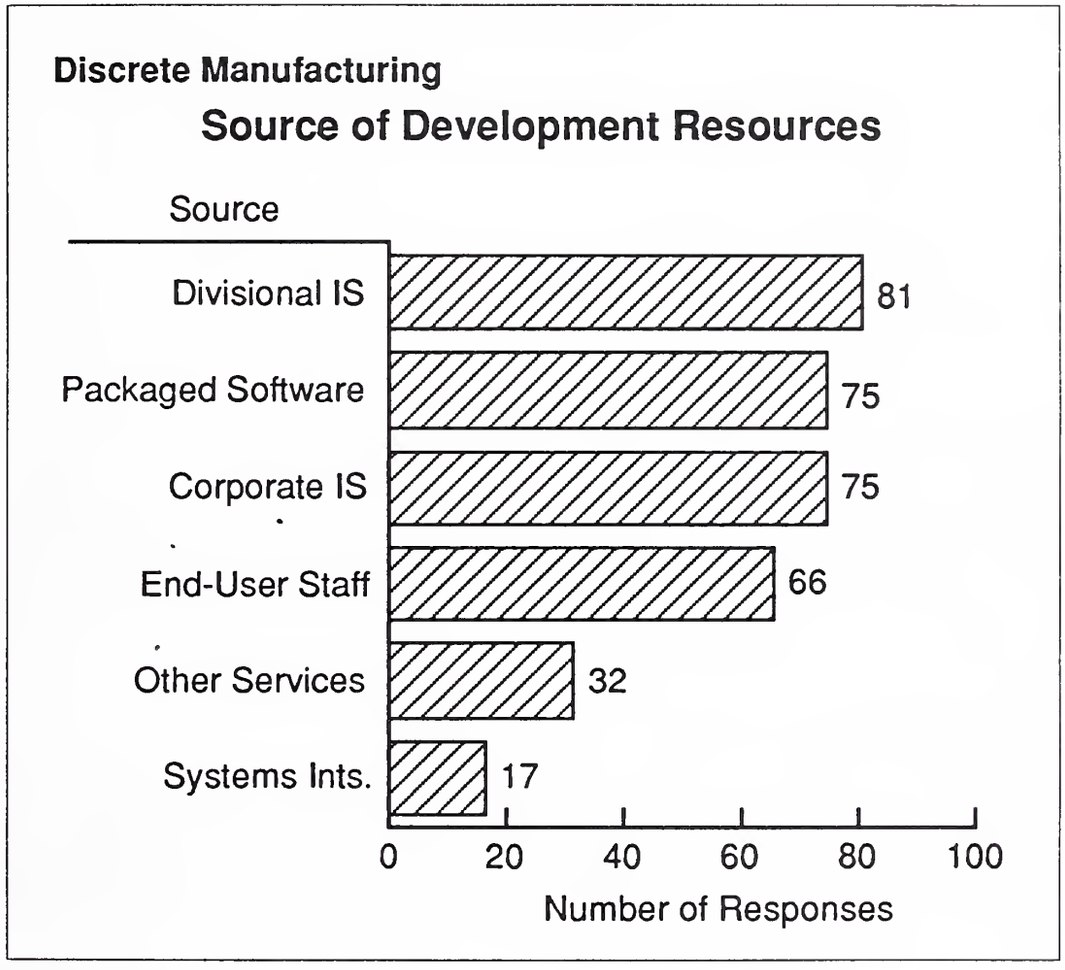
INPUT anticipates increased expenditures for IS to be included in the discrete manufacturing departmental budgets. Although client/server implementation looks like downsizing to the IS department, it also results in increased power to the end-user. As Exhibit IV-4 shows, survey respondents in the discrete manufacturing sector concur with INPUT's analysis of end-user involvement.

EXHIBIT IV-4



3. Changes in Systems Integration or CIM in Discrete Manufacturing

Exhibit IV-5 shows that the old hierarchical approach to discrete manufacturing systems integration (or CIM) had two major drawbacks. First, each database was its own island, and often wasn't accessible from other departments. Second, a significant amount of hardware and software integration was required. Added to those complexities is the high cost of computers and the lack of LAN power to move data quickly.

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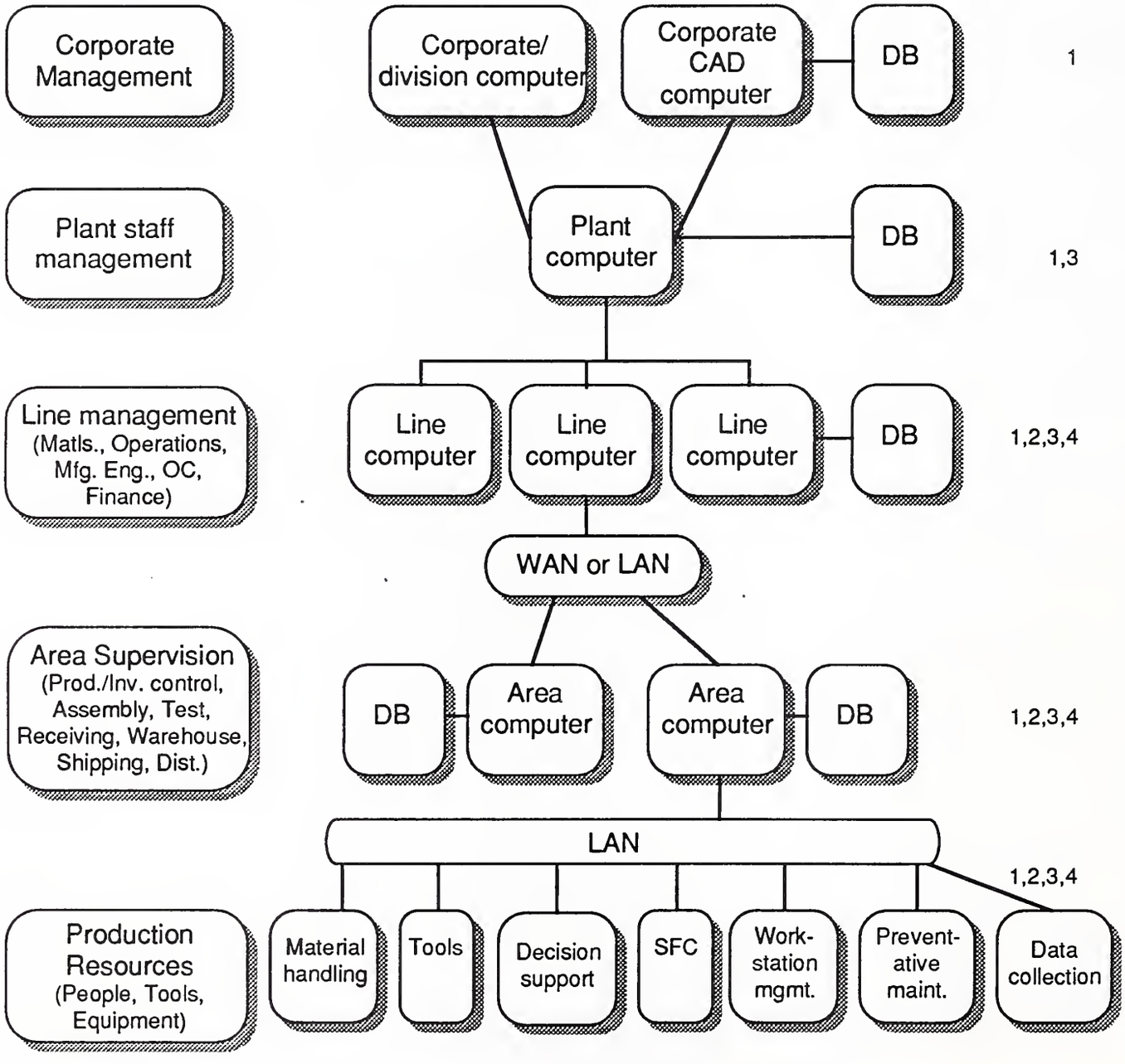
EXHIBIT IV-5

Discrete Manufacturing

Old Manufacturing Control Hierarchy



1 = Software integration
2 = Hardware integration
3 = Plant scheduler
4 = Quality monitor

DB = Database
WAN = Wide-Area Network
LAN = Local-Area Network
SFC = Shop Floor Control

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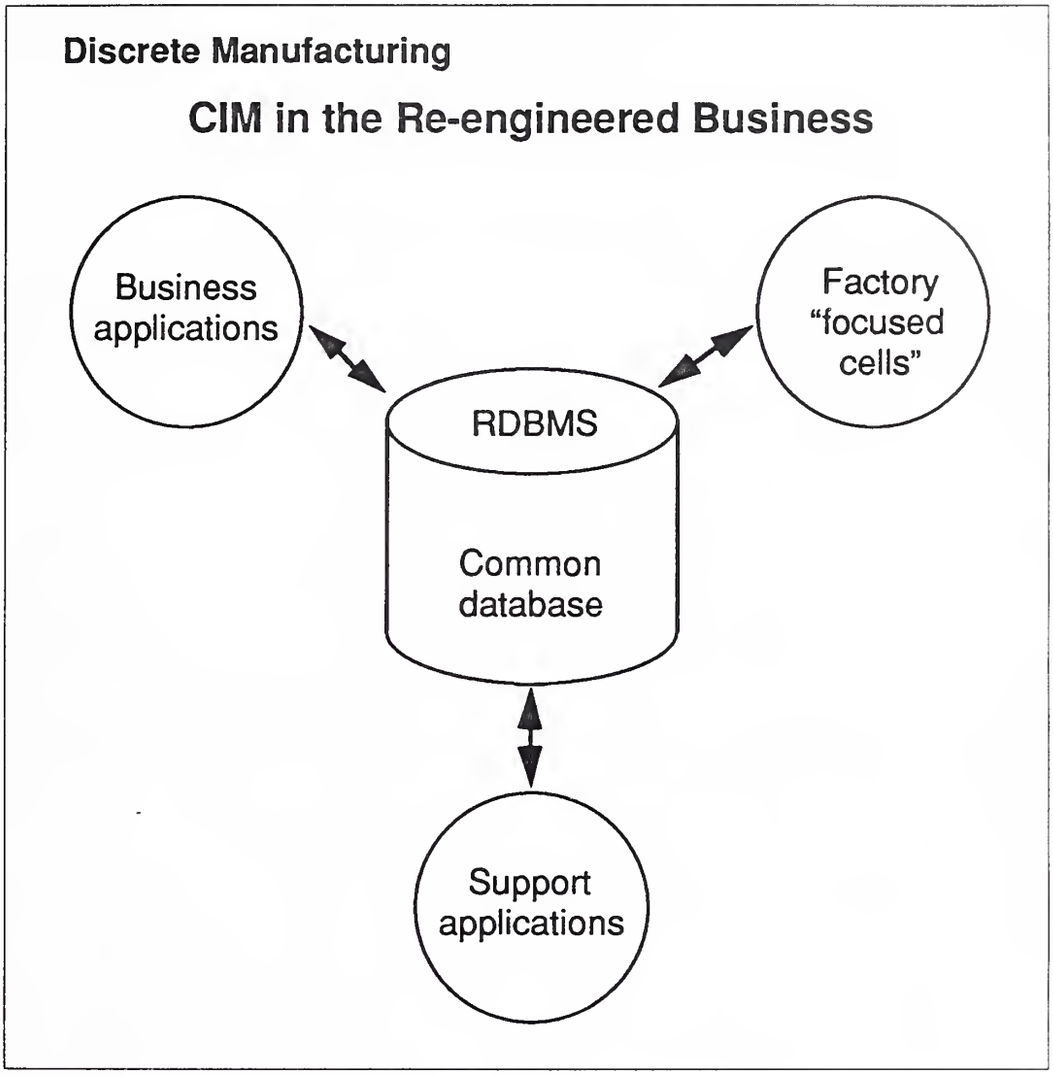
Current concepts used as business re-engineering takes place are much simpler in structure, as shown in Exhibit IV-6.

EXHIBIT IV-6



Each focused cell accesses data it needs and information is shared by all. Exhibit IV-7 shows the relationship of new IS structures to the re-engineered business. It also shows opportunities to use information services for a variety of purposes, all in a totally integrated environment.

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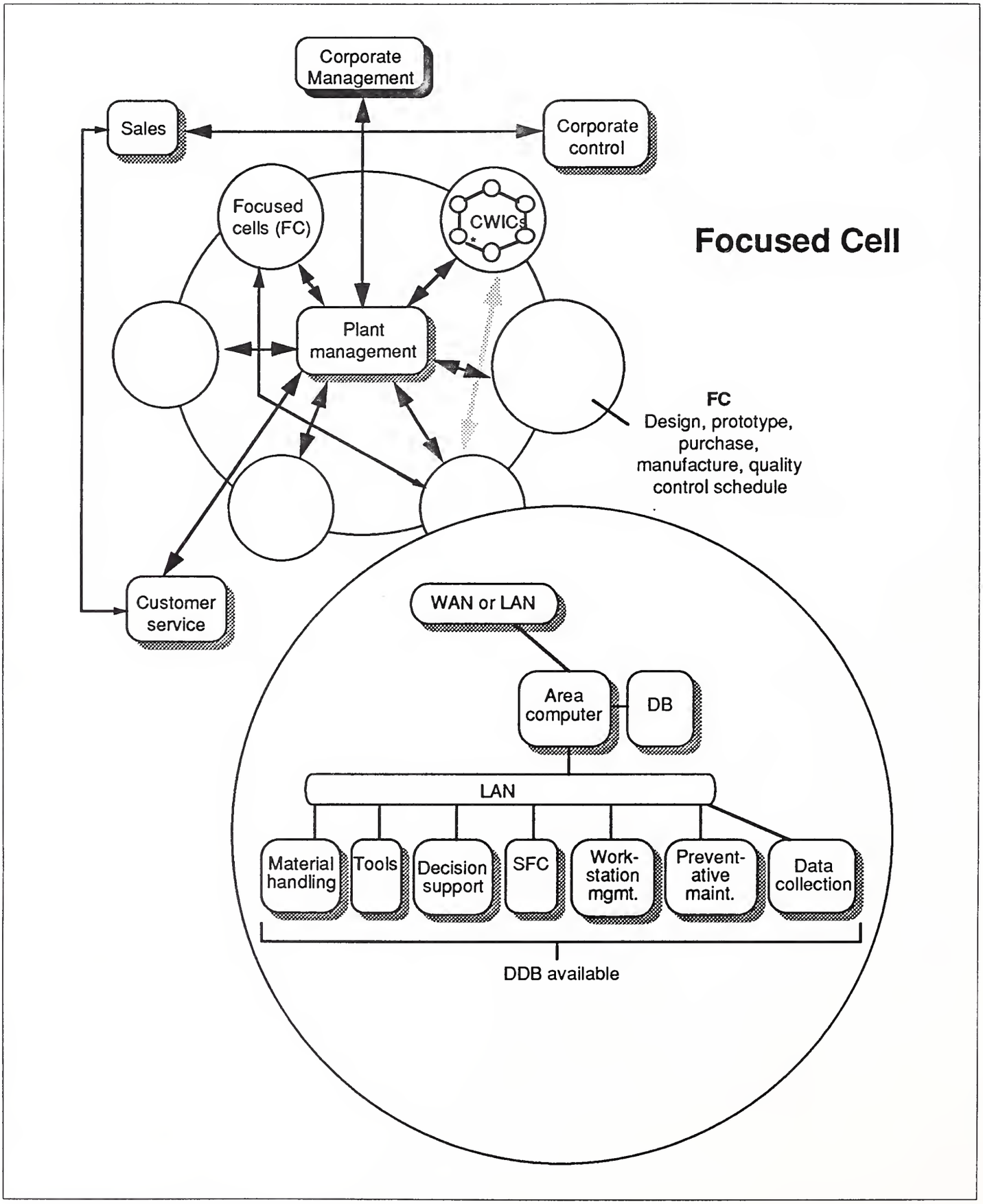
EXHIBIT IV-7



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Exhibits IV-8 through IV-11 show where opportunities for specific expertise and applications in discrete manufacturing should appear in the 1990s. The areas are divided into functional separations derived from re-engineered structures. As open systems proliferate, so will the opportunities for specific applications development.

EXHIBIT IV-8

Application Use by Discrete Manufacturers

Strategic and Planning

- Lead tracking
- Enterprise resource planning
  - Forecasting
  - Material requirements
  - Capacity requirements
  - Labor/machine requirements
  - Production

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EXHIBIT IV-9

Application Use by Discrete Manufacturers

Tactical and Execution

- Sales
- Order entry/configuration
- Scheduling/rescheduling
- Process and product quality assurance
- Purchasing
- Receiving and inspection
- Labor/machine tracking
- Maintenance prevention/emergency
- Shipping
- Inventory control
- Logistics/distribution
- Customer follow-up
- Reporting/communications

EXHIBIT IV-10

Application Use by Discrete Manufacturers

Control and Accounting

- Accounts payable
- Accounts receivable
- Payroll
- General ledger
- Regulatory compliance

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EXHIBIT IV-11

Application Use by Discrete Manufacturers

Support

- Customer service
  - Serial and lot control by site
  - Maintenance scheduling
  - Call handling
  - Follow-up
- Engineering
  - Design
  - Prototype
  - Manufacturing oversight
  - Quality assurance
- Human resources

D
Process Manufacturing

1. General Overview

A process operation identifies the form of the material used at the beginning of the operation and its form after use. If the material changes form during production and cannot be uniquely identified in the end product, then a process operation occurred. Additionally, if the input material cannot be brought back to its original form, then a process changed it.

Companies in the process sector exhibit unique requirements typically fulfilled by their management information systems:

- Recipes are used instead of plain bills of material.
- Process operations, or work instructions, must be used constantly and consistently.
- There are often intermediate steps in the production of goods.

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- Many process companies generate "byproducts" and "company products" during the production process.
- Lot traceability is a necessity.
- Unit-of-measure conversions can be complicated.
- Regulatory compliance complexity increases.
- Distribution logistics and traffic management can be major concerns.

Restructuring occurs on a large scale throughout process manufacturing companies. Major elements are similar to those identified in Exhibit IV-2 for Discrete Manufacturing.

Transformation from a hierarchical to a cellular decision support structure occurs in the process manufacturing industries.

Regulatory issues have a major impact on the process manufacturing industry. Exhibit IV-12 shows a number of regulatory issues.

EXHIBIT IV-12

Process Manufacturing

Regulatory Constraints

Industry	Regulation
Chemical/Petroleum/Paper	EPA/Green Movement
Food/Beverage	FDA/NLEA 1990
Pharmaceutical	FDA/Electronic Filing

New regulatory requirements are constantly introduced and modified. In the chemical industry, regulations support "right to know" requirements that provide information to the public. Material Safety Data Sheets (MSDSs) must provide information on every product for hazardous materials tracking. Companies face hefty fines if they do not comply, so regulatory issues become a critical part of running these businesses.

Many process manufacturers and IS vendors cited ISO 9000 as a key regulatory issue impacting their ability to compete internationally. ISO 9000 requires companies that want to do business in Europe to obtain vendor certification. This requires detailed documentation of internal business processes. European customers establish partnering agreements and do business only with certified vendors.

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However, advanced information technology at the PC/workstation level allow chemical companies to track waste and maintain Material Safety Data (MSDS) documentation. Electronic filing to the federal government in the pharmaceutical industry allows companies to provide needed information on-line. Streamlining paperwork associated with regulation allows companies to be more competitive and speeds up the process of introducing new products. The performance levels required to meet expectations force more companies to re-engineer and incorporate TQM principles, leading to greater automation and systems integration (CIM) techniques.

2. Information Technology Trends

Process manufacturers have established many islands of automation in the last two decades. The need for things like automated process controls, automated conveyor systems and uses of EDI forced computerization in specific areas of business. Most business and planning systems were customized and "homegrown"; a few years ago, application packages were not available. This situation has changed, so process manufacturers may now take advantage of their past automation, combined with new application packages, to implement integrated client/server solutions.

INPUT also anticipates that end-user department budgets will include much of the increased expenditures for IS in process manufacturing companies. As Exhibit IV-13 shows, survey respondents concur with INPUT's analysis of end-user involvement. Packaged software, in particular, is a more important element in the plans for change.

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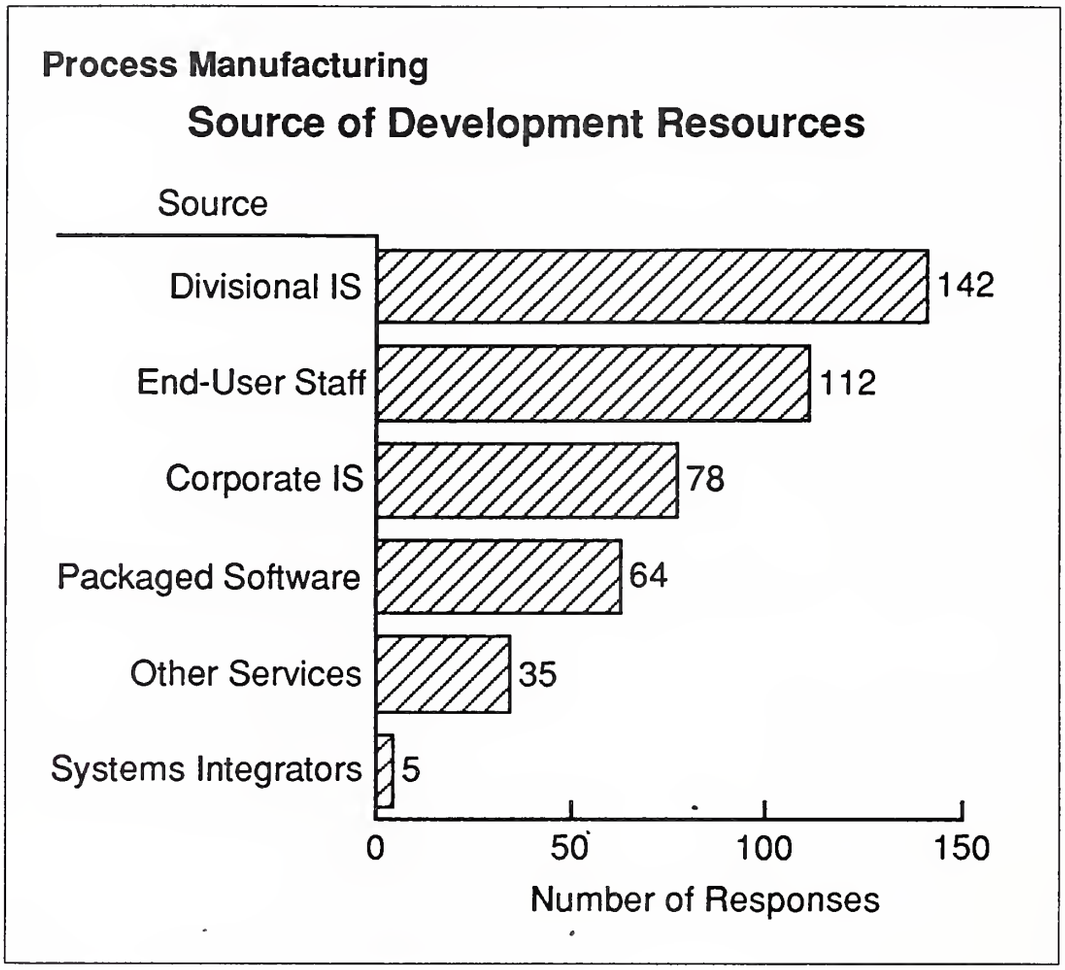
EXHIBIT IV-13



An important element in process manufacturing shop floor production is the programmable logic controller (PLC), which greatly improved in recent years and are now used in new ways. PLCs are delivered with embedded computers that contribute to total quality management performance. In addition, to load programs and control machinery, PLCs now transmit and receive information from shared RDBMS. They are also used as data collection devices for immediate information availability, and are the primary source for quality statistical process control (SPC).

An important development in process manufacturing is the appearance of "cell controllers" and "application enablers." As TQM principles are implemented, statistical process control (SPC) becomes a necessity. Numerous devices and computers (most machines are now delivered with embedded computers) must be connected to share data. Until the late 1980s, these devices were integrated on a customized basis. Several companies have not developed standard device "drivers" or "servers" that recognize disparate protocols, enabling equipment and software to "interoperate." For example, bar code readers, CNC machines, PLCs and computers converse in what appears to be a common language, without custom integration efforts.

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Exhibits IV-14, IV-15 and IV-16 note where opportunities for specific expertise will be required in the 1990s in process manufacturing. The areas are divided into functional categories derived from re-engineered structures. The process manufacturing companies, due to many past automation efforts, offer excellent opportunities to vendors of "niche" products, particularly where openness and ease of integration are present. It appears likely that many mainframe applications, such as financial, will stay in place, while daily operational systems change. The new systems must easily integrate with the old.

EXHIBIT IV-14

Application Use by Process Manufacturers

Tactical and Execution

- Lead tracking
- Enterprise resource planning
- Sales
- Order entry/configuration
- Scheduling/rescheduling
- Process and product quality assurance
- Purchasing
- Receiving and inspection
- Labor/machine tracking
- Maintenance prevention/emergency
- Shipping
- Inventory control
- Logistics/distribution
- Customer follow-up
- Reporting/communications

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EXHIBIT IV-15

Application Use by Process Manufacturers

Control and Accounting

- Accounts payable
- Accounts receivable
- Payroll
- General ledger
- Regulatory compliance
- Costing

EXHIBIT IV-16

Application Use by Process Manufacturers

Support

- Customer service
  - Serial and lot control by site
  - Call handling
  - Follow-up
- Engineering
  - Flow design
  - Process quality
  - Manufacturing oversight
  - Quality assurance
- Human resources

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A key application development area is improved customer service. Because this is the major issue for TQM, "customer support" and "customer responsiveness" systems are quickly being developed. There are six segments to these applications:

- Taking orders and committing delivery dates (typically through EDI).
- Maintaining specific customer data in relation to business practices.
- Sharing data with production so customer needs and requests are accurately communicated.
- Tracking lot numbers throughout the production process, including all intermediate steps, and maintaining that data through the life of the product.
- Call handling and follow-up.
- Especially in process manufacturing, handling distribution logistics to multiple delivery points with consideration for "shelf-life."

A surprising number of process manufacturing companies anticipate a complete change in their Manufacturing Resource Planning (MRP) II packages. Nearly all this change is related to client/server implementation and the move to downsize. Costs associated with old mainframe systems can be restrictive, especially in maintenance. Mainframe-based vendor software maintenance charges can be as high as $100,000 annually, but newer MRP II systems are much less expensive. Maintenance is charged as a percent of the sales price, so less expensive systems have lower recurring charges. The typical client/server MRP II system is sold by "seat" (defined as the number of concurrent users), so it can be relatively inexpensive to start up a new system and then add seats as the implementation matures.

Many process manufacturers are still in the home-grown, legacy system mode. Because many of these companies are very large, with numerous plants, distribution centers and delivery points, those legacy systems will remain in place for some time. Systems are usually highly customized, so it will be difficult for packaged software vendors to meet all the perceived needs. Effective process software products that satisfy most user needs (as previously mentioned) are coming to market, but high levels of customization are still required. This environment, however, could rapidly change with the advent of open systems.

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E

Need for Open Systems Solutions

The interconnectivity and interoperability needs required for an integrated manufacturing systems environment will lead to an increasing demand for open systems solutions, helping to reduce cost, complexity and maintainability of integrated solutions.

Standards are now being adopted so that open systems can become a reality. The strongest move in that direction has been acceptance of UNIX as an operating system in the manufacturing environment. The trend began in engineering departments, and as workstations improved and UNIX matured, entire plants embraced the standard. UNIX, in its many different forms, does not constitute true openness. The important point is that UNIX is the beginning of standards development that should bring true open systems in the late 1990s.

F

Leading U.S. Vendors of Manufacturing Application Software Products

The largest markets for manufacturing application software, as reflected in the revenues of leading manufacturing software product vendors, are computer-aided design (CAD) and business management planning solutions, such as materials requirements planning and manufacturing resources planning tools. However, many cross-industry applications software products, such as financial/budgeting packages, have been tailored for the manufacturing market. They are often provided by vendors who offer broad-based applications software product solutions to the discrete and process manufacturing industries.

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Leading independent providers of industry-specific manufacturing software product, as measured by 1992 revenues, are included in Exhibit IV-17.

EXHIBIT IV-17

Leading Independent Vendors of Industry-Specific Manufacturing Software Products

- Computer Associates
- System Software Associates
- The ASK Group
- Autodesk
- American Software
- SAS Institute
- Marcam
- Cincom Systems
- Dun & Bradstreet Software
- Ross Systems
- SAP America, Inc.

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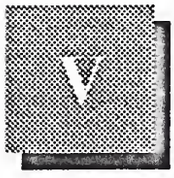

Keys to Success In Penetrating Discrete and Process Manufacturing SI Markets

A
Targeting Opportunities

1. Opportunities for Large Prime SI Contractors

Recent SI history in discrete and process manufacturing indicates that companies using systems integration vendors (identified by INPUT as large prime contractors) are primarily the Fortune 1000 companies.

Much of this discrete manufacturing SI customer base is concentrated in the defense and automotive industries. In process manufacturing, this base consists of the large producers of oil, gas, chemical, paper and metals.

Many of these industries face intense global competition, and company-wide operations restructuring appears to be a principal motivating factor in working with third-party systems integrators. The systems integration needs of these companies are usually very complex. Often, information resources must integrate across several corporate divisions in different countries.

Many of these industries provide commodity-type products, and in a slower growing world economy, survival forced change upon individual companies within these industries.

In other words, companies using third-party systems integration in recent years have reacted to adverse business conditions. For the future, such contracts, where successful, should be used by systems integrators as references to target potential systems integration customers with a proactive (preventative) message.

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Pharmaceutical, food processing and the hardware segments of the manufacturing electronics industry appear to be the large manufacturing industry groups which could benefit from restructuring with (identified by SIC code) productivity enhancement likely from the more efficient use of information resources.

These three groups were among the major growth industries of the 1980s; but more recently, companies in these industries show slower growth not only due to the recession (which impacted their unit growth, in particular) but also from the lack of pricing flexibility that existed in the 1980s.

Targeting large companies in these markets is best done by a front-end strategic planning approach, with emphasis on business process re-engineering. In addition, many companies could benefit from outsourcing some of their business segments, particularly those not considered mission-critical. Systems integration companies with strong front-end consulting and/or operations management reputations have some advantage in addressing the large companies with an integrated SI capability.

In addition, many suppliers and customers of large corporations are increasingly becoming candidates for systems integration contracts that provide EDI/electronic commerce integration with their trading partners.

2. Manufacturing Industry Opportunities for Midsized SI Contractors

Some of the most common systems integration needs of manufacturing companies are in network and database integration, and migration of applications from legacy systems to client/server platforms. For these types of contracts, technical expertise as well as industry-specific knowledge is particularly critical to successful bids.

Strong capabilities in the more advanced application development tools and methodologies are very important. These should include frameworks for efficient application development, including middleware solutions for building distributed applications, and strong object-oriented and distributed relational database technology expertise. Increasingly, suppliers are developing template-like solutions for particular industries that provide easily customizable solutions, often benefiting from prior installations in a comparable industry.

Many systems integrators addressing such markets partner with other vendors to achieve the broad base of technical skills and industry expertise necessary to compete with large, fully-integrated systems integrators.

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Many of these companies classify themselves more as professional services companies, with targeted solutions. As indicated previously in this report, the lines between what is a professional services company, systems integrator or systems management company will continue to blur over the next several years, as companies from each of these delivery modes bid for more systems integration contracts.

3. Opportunities for Value-Added Resellers

Particularly in smaller companies, value-added resellers who have traditionally identified themselves as turnkey systems suppliers are now billing themselves as systems integrators. An identifying characteristic of a systems integrator is one that can provide a more flexible solution, with a broad-based capability in a number of software and hardware technologies, rather than a highly tailored solution.

Value-added resellers should develop strong industry and technical expertise, particularly with open systems (offering portability of applications) and client-server (integrated) applications. The complexity of such solutions increasingly requires third-party outsourcing and often includes systems and network management, as well as training services support. Thus, value-added resellers should emphasize their role as technology facilitators within particular industries, with strong skills in network integration and related support services.

B

Successful Marketing Approaches

INPUT surveyed systems integration vendors in 1993 on what they considered to be significant factors in recent successful SI contract bids. Exhibit V-1 indicates technical excellence and competitive price were the most important factors.

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EXHIBIT V-1

SI Vendor Contract Win Factors*

Factor	Percent of Responses
Technical Excellence	31
Competitive Price	23
Full Services/BPR Capabilities	15
Industry Track Record	15
Partnership Commitment	15
Global Infrastructure	15
Best Value	8
Cultural Fit	8
Specific Business Knowledge	8
Tangible Benefits To Customer	8

*Multiple responses available

Responses suggest that at this stage of SI industry development, vendors play the role of technology facilitator most frequently in SI engagements. At the present stage, for the largest number of customers, SI contractors are hired mainly for the level of technical expertise they bring to the customer's organization.

Cost, the second most frequently mentioned factor, indicates user concerns about price and getting the best value for their investment.

Business and customer-specific issues comprise the remaining reasons for winning SI business. Collectively, these factors point to strengths attributed to vendors with full-service capabilities, industry-specific track records, BPR capabilities, life-cycle support, business partnership cultural fit and a global infrastructure. These vendor capabilities and qualities will become increasingly important in selecting SI contractors. User desires to implement the best business practices will be a key driving force for buying SI services from vendors in future years.

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The trend for user organizations to ask "What value to my organization can I expect to receive from an SI relationship?" is gaining momentum. Third-party systems integrators are expected to reduce costs, improve productivity, offer strategic expertise within industries and reduce internal risk of application development.

A key factor for differentiating SI skills to a potential customer is a strong reputation based on previous contracts within an industry. Smaller SI vendors, in particular, should leverage niche application expertise into other areas of the enterprise.

In the future, as the SI market becomes more competitive, a very important vendor competitive approach will be to become a full-service provider to the customer, based on a longer-term business-partner relationship. Entry into this relationship often comes as a result of providing the front-end business process re-engineering solution. This leads to building specific business solutions that incorporate the consultant's methodologies as well as to develop what could become the master plan for business process change throughout the organization. This in turn leads to more flexibility in negotiating contract terms, such as the development of total solution (bundling) pricing approaches to SI services.

A key marketing factor for SI vendors is to develop customers into long-term business partners. The value-added pricing component in systems integration over the longer term is likely to be more in the breadth and uniqueness of ongoing services. Pricing of the product elements of the systems integration solution is also likely to become much more price-sensitive in the future, with software and other types of tradeoffs made to obtain more long-term services businesses.

SI vendors who have the capital resources should also consider strategic funding of development and implementation that would also include leasing of completed systems to the customer. An advantage to the vendor is that the system can be remarketed to multiple potential customers. The pay-back potential from repeatable sales could be high over the extended repeatable life cycle of the system.

Over the long term, success in the SI industry will be segmented between large full-service suppliers and companies with strong technical skills, such as software development, that develop longer-term services contracts in software maintenance (re-engineering), network or systems management and customer training from targeted individual customer projects.

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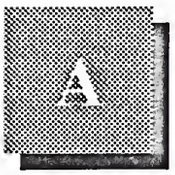

Definition of Terms

A
Introduction

INPUT's *Definition of Terms* provides the framework for all of INPUT's market analyses and forecasts of the information services industry. It is used for all U.S. programs. The structure defined in Exhibit A-1 is also used in Europe and for the worldwide forecast.

One of the strengths of INPUT's market analysis services is the consistency of the underlying market sizing and forecast data. Each year INPUT reviews its industry structure and makes changes if they are required. When changes are made they are carefully documented and the new definitions and forecasts reconciled to the prior definitions and forecasts. INPUT clients have the benefit of being able to track market forecast data from year to year against a proven and consistent foundation of definitions.

B
Overall Definitions and Analytical Framework

Information Services are computer/telecommunications-related products and services that are oriented toward the development or use of information systems. Information services typically involve one or more of the following:

- Use of vendor-provided computer processing services to develop or run applications or provide services such as disaster recovery or data entry (called *Processing Services*)
- A combination of computer equipment, packaged software and associated support services which will meet an application systems need (called *Turnkey Systems*)

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- Packaged software products, including systems software or applications software products (called *Software Products*)
- People services that support users in developing and operating their own information systems (called *Professional Services*)
- The combination of products (software and equipment) and services where the vendor assumes total responsibility for the development of a custom integrated solution to an information systems need (called *Systems Integration*)
- Services that provide operation and management of all or a significant part of a user's information systems functions under a long-term contract (called *Systems Operations*)
- Services that support the delivery of information in electronic form—typically network-oriented services such as value-added networks, electronic mail and document interchange (called *Network Applications*)
- Services that support the access and use of public and proprietary information such as on-line databases and news services (called *Electronic Information Services*)
- Services that support the operation of computer and digital communication equipment (called *Equipment Services*)

In general, the market for information services does not involve providing equipment to users. The exception is where the equipment is part of an overall service offering such as a turnkey system, a systems operations contract or a systems integration project.

The information services market also excludes pure data transport services (i.e., data or voice communications circuits). However, where information transport is associated with a network-based service (e.g., electronic data interchange services), or cannot be feasibly separated from other bundled services (e.g., some systems operations contracts), the transport costs are included as part of the services market.

The analytical framework of the information services industry consists of the following interacting factors: overall and industry-specific business environment (trends, events and issues); technology environment; user information system requirements; size and structure of information services markets; vendors and their products, services and revenues; distribution channels; and competitive issues.

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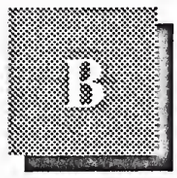

Questionnaire

INPUT, a leading provider of market research and management consulting services on the information services markets, is studying how third-party systems integrators can enhance their SI services offerings to the discrete and process manufacturing vertical markets.

As part of this study, INPUT is interviewing a number of U.S. manufacturers who are implementing systems integration projects either through internal or external systems integration resources.

1) Relative importance of manufacturing information technology, involving internal or external SI-based solutions

Rate the following SI-related technologies as to their importance to your current or future computerized manufacturing operation on the following scale of 1 to 5, where 5 means extremely high, and 1 means extremely low.

a. Network Integration	1	2	3	4	5
b. Integrated Databases	1	2	3	4	5
c. Distributed Network Management	1	2	3	4	5
d. Distributed Systems Management	1	2	3	4	5
e. Open Systems	1	2	3	4	5
f. Workflow-based applications	1	2	3	4	5
g. Multimedia applications	1	2	3	4	5
h. Enterprise Resource Planning	1	2	3	4	5
i. Imaging—Document Processing	1	2	3	4	5
j. Wireless Communications	1	2	3	4	5
k. Expert Systems	1	2	3	4	5

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l. Parallel Processing	1	2	3	4	5
m. Manufacturing Execution Systems	1	2	3	4	5
n. EDI/Electronic Commerce	1	2	3	4	5
o. Other _____	1	2	3	4	5

2) Planned SI applications that could involve either internal or external systems integration resources

Please check the following SI applications you plan to implement over the next one to three years.

a. _____ Integration of islands of automation (design, engineering, planning, production)

b. _____ LAN to LAN integration

c. _____ LAN to WAN integration

d. _____ Migration from legacy to distributed systems solutions

e. _____ Development of standard (GUI) user interfaces across the enterprise

f. _____ Integration of enterprise-wide applications through integrated RDBMS

g. _____ Replacement of batch-oriented systems with on-line (real time) applications

h. _____ Implementation of TQM (Total Quality Management) System

i. _____ Implementation of an open systems strategy

j. _____ Development of a document management/workflow inter-departmental solution

k. _____ Initiation of a life-cycle environmental impact analysis system

l. _____ Implementation of total demand planning solution

m. _____ Implementation of activity-based costing system

n. _____ Enhancement of customer services interfaces

o. _____ Integration of design application and manufacturing process functions

p. _____ User training programs involving enterprise-wide information access

q. _____ Client/server (downsizing/rightsizing) implementation

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r. _____ Supply chain linkage (EDI/electronic commerce)

s. _____ Other: Explain: _____

3) Would you consider the use of an outside systems integrator to implement any of the above applications? _____Yes _____No

If no, please explain.

---

4) What do you consider to be the most important criteria your selection of outside systems integrator?

Please rank on a scale of 1 to 5, with 5 being the highest level of importance.

a. Strong references	1	2	3	4	5
b. Industry knowledge	1	2	3	4	5
c. Broad set of SI services capabilities	1	2	3	4	5
d. Financial strengths	1	2	3	4	5
e. Business Process Re-engineering capabilities	1	2	3	4	5
f. Project/Program Management Strengths	1	2	3	4	5
g. Global Infrastructure	1	2	3	4	5
h. Strengths in applications development/maintenance	1	2	3	4	5
i. Systems operations/ facilities management capabilities	1	2	3	4	5
j. Strategic partnerships with leading vendors	1	2	3	4	5
j. Compatible business cultures/values/which would enhance partnering	1	2	3	4	5
k. Strong field support capabilities	1	2	3	4	5

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l. Training Programs	1	2	3	4	5
m. Pricing Alternatives	1	2	3	4	5
n. Financing of SI program	1	2	3	4	5
o. Best technology	1	2	3	4	5

4) Preferred pricing approaches of SI vendors

Please rank satisfaction as a user with the following contract negotiation approaches by systems integrators, as to degree of preference, with 5 representing the highest level.

a. Fixed prices	1	2	3	4	5
b. Cost/plus	1	2	3	4	5
c. Usage based	1	2	3	4	5
d. Time dependent	1	2	3	4	5
e. Based on risk assessment	1	2	3	4	5
f. Incorporation of performance clauses	1	2	3	4	5
g. Incorporation of warranties /guarantees	1	2	3	4	5
h. Best value	1	2	3	4	5
i. Other _____	1	2	3	4	5

5) What, if any, impact will the incorporation of a corporate open systems strategy have on the impact of the nature of systems integration projects in the future?

_____

_____

_____

_____

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